WATER & SEWAGE WORKS

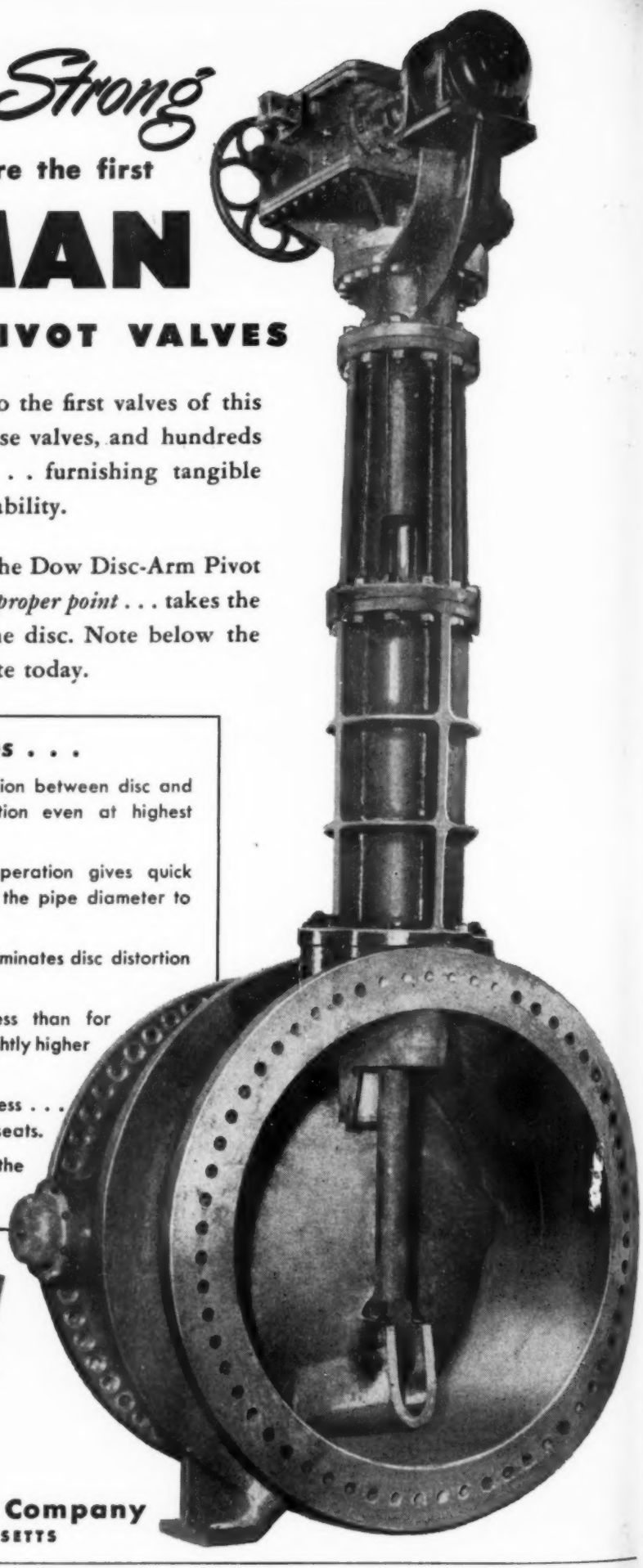
INDUSTRIAL WATER SUPPLY IN THE MAKING—BIG SPRING, TEXAS

Still Going Strong

after more than 25 years are the first

CHAPMAN

DOW DISC-ARM PIVOT VALVES



More than a quarter of a century ago the first valves of this design were installed. And today these valves, and hundreds more, are giving excellent service . . . furnishing tangible evidence of unusual strength and reliability.

An improved type of butterfly valve, the Dow Disc-Arm Pivot Valve *applies the operating force to the proper point* . . . takes the deflection out of the lower half of the disc. Note below the advantages of this design . . . then write today.

Check These Advantages . . .

NO VIBRATION! Because of direct connection between disc and operating mechanism there is no vibration even at highest velocities.

FAST OPERATION! Simple and direct operation gives quick closing in emergencies . . . only one-half the pipe diameter to travel.

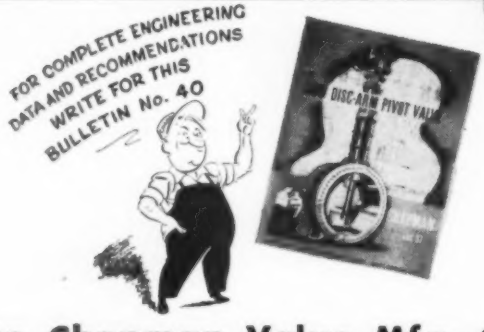
EXTREME TIGHTNESS! This unusual design eliminates disc distortion . . . ensures extreme tightness.

LOW HEAD LOSSES! Head losses are less than for needle or plunger type valves . . . only slightly higher than gate valves.

SMOOTH OPERATION! None of the jerkiness . . . none of the wear of valves with sliding seats.

EASY INSPECTION! Disc mechanism is on the downstream side when valve is closed.

FOR COMPLETE ENGINEERING DATA AND RECOMMENDATIONS WRITE FOR THIS BULLETIN No. 40



The Chapman Valve Mfg. Company

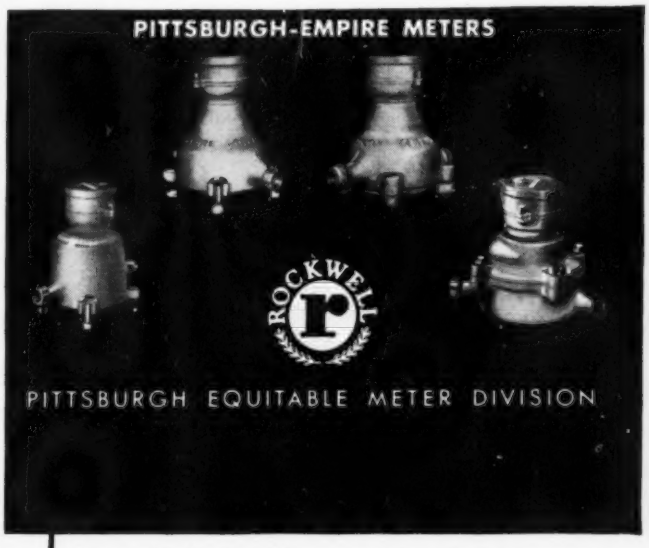
INDIAN ORCHARD, MASSACHUSETTS

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. October, 1949. Volume 96. Number 10. Published monthly by Gillette Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Per copy, 25c; Subscription rate: United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as second-class matter March 4, 1948, at the post office at Mount Morris, Illinois, under Act of March 3, 1879.
Executive and business offices, 22 W. Maple St., Chicago 10, Illinois. Editorial office, 155 E. 44th St., New York 17, N. Y.

Chester Conklin, former meter reader (now promoted to maintenance) watches wistfully as new Meter Readerettes salute The Great Gildersleeve before starting out to read 'em.

Hydrants present a tough hurdle. "This doesn't look like the meter Mr. Gildersleeve showed us . . . but maybe it's the large economy size."

"I wonder what they mean by a curb meter? It just says here: 'Unscrew the disaflous, then the samastrope will be in plain view'." (The gal can't even read the manual.)



But seriously speaking, you can always read Pittsburgh-Empire meters and profit from their accuracy.

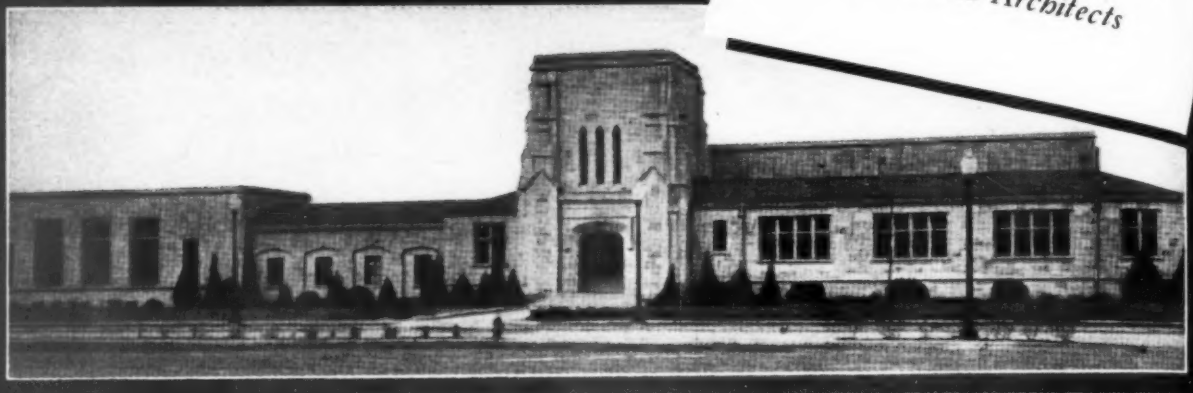
Next month Gildy finds out the girls can't read meters either—

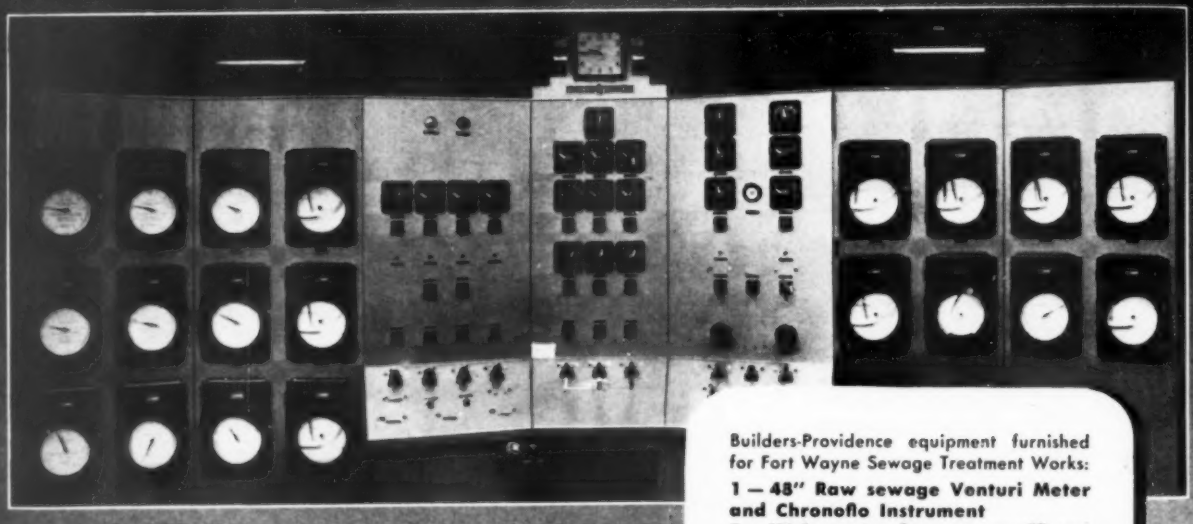
FORT WAYNE, IND.

Sewage Treatment Works

(Completed in 1941)

CHAS. W. COLE and SON
Engineers and Architects





Using the activated sludge system, this modern plant built by Charles R. Wermuth and Son, Inc. has solved a serious sewage disposal problem for the city of Fort Wayne, Ind. In this plant the L. H. Prentice Co. of Chicago installed a total of 25 Builders Meters and Chronoflo Instruments to keep accurate accounting of sewage, sludge, effluent, gas, and air flows. Convenient location of receiving and summation instruments at central control panels greatly facilitates plant operation. For Bulletins describing Builders sewage works equipment, address Builders-Providence, Inc. (Division of Builders Iron Foundry), Providence 1, R. I.

Builders-Providence equipment furnished for Fort Wayne Sewage Treatment Works:

1 — 48" Raw sewage Venturi Meter and Chronoflo Instrument
3 — Weir meters for sewage effluent with summation on central control panel
3 — 16" Return sludge Venturi Meters with summation on central control panel
2 — 6" Venturi Meters (waste sludge — air) and Chronoflo Instruments
3 — 8" Venturi Meters (sludge — supernatant liquid) and Chronoflo Instruments
1 — 6" Sewage gas Orifice Meter and Chronoflo Instrument
1 — 22" and 2 — 18" Nozzle Meters (Intake Air) with summation on central control panel
3 — 4" and 3 — 3" Orifice Air Meters with Manometers
3 — 16" Orifice Air Meters with summation on central control panel

BUILDERS PROVIDENCE
Instruments

WATER & SEWAGE WORKS

WATER SUPPLY—SEWAGE DISPOSAL—INDUSTRIAL WASTE TREATMENT

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

COMING

Fluoridation—1949

In our November 1948 issue an article by H. A. Faber discussed the pros and cons of Water Fluoridation under the caption "Shall Fluorides Be Added to Public Water Supplies?" In the interim much water has flown under the bridge in fluoridation and it is now timely to publish a follow-up article which relates fluoridation developments of the year, and brings this important subject up to date. Again the author is Editorial Associate—

HARRY A. FABER, Research Chemist,
The Chlorine Institute, New York.

Effects of Sewage Quality on Treatment Plant Performance

Is the story of the effects of septic or stale colloidized sewage on the performance and operating economy of sewage treatment plants. This article presents case histories as proof that "good housekeeping," as it applies to sewer and pumping station operation and maintenance, is effective in reducing loadings on secondary treatment processes, avoiding damage to structures by sulphide gas, correction of odor nuisances and lowered costs of chlorination. These experiences are related by—

ELSON T. KILLAM,
Consulting Engr., New York.

Service Line and Extension Trencher

Interesting and timely is the description of a jeep-mounted trencher, which has proved so handy for making water service line installations and small main extensions, with material savings in labor costs and time. Some cost comparisons indicate when and how this useful piece of equipment can most effectively be employed. The author is—

H. E. LORDLEY, Asst. Director,
Dept. of Utilities, Richmond, Va.

The B.O.D. Test—a Critical Examination

Constitutes a report on the chief shortcomings of the Standard 5 Day B.O.D. Test with warnings to users of the test when applied to sewages as well as trade wastes. Considering the number of potential vitiating influences the investigator offers a number of warnings to those who may not adequately appreciate the deficiencies of the B.O.D. test or the value of the C.O.D. (chemical oxygen demand) test in combination with the biologic demand test. This critical analysis comes from—

ROBERT S. INGOLS, Research Prof.,
Ga. Institute of Technology, Atlanta, Ga.

Softening Plant Capacity Doubled at La Verne

Is the title of the article which describes the increase in size of the water softening and filter plant of the Metropolitan Water District for Southern California at La Verne, Calif. How this combination lime and zeolite softening plant was increased from 100 to 200 mgd. capacity is told by—

W. W. AULTMAN, Water Purif. Engr.,
Metropolitan Water Dist. of Southern Calif.

Maintaining Transmission Line Capacity with Ammonia-Chlorine Treatment

Has now been successfully practiced at Utica, N.Y., for 15 years. Observations on this treatment at Utica at the end of the first 3 years were first reported in this magazine in 1937. Now after 12 more years of operation, some definite and indisputable conclusions have been drawn by

L. J. GRISWOLD, Engr.,
Bd. of Water Supply, Utica, N.Y.

Chromium Removal by Ion Exchange

Has been studied as a means of eliminating this toxic substance from plating waste waters. This research which has also involved a study of the chemistry of chromium, is reported by—

Prof. DON E. BLOODGOOD and A. STRICKLAND,
Purdue University, Lafayette, Ind.

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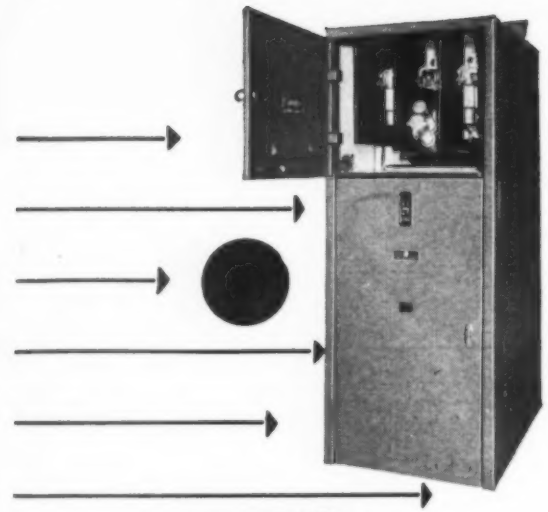
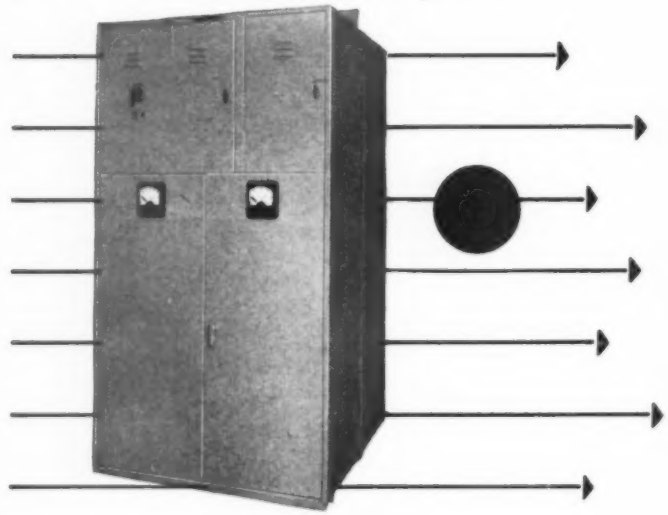
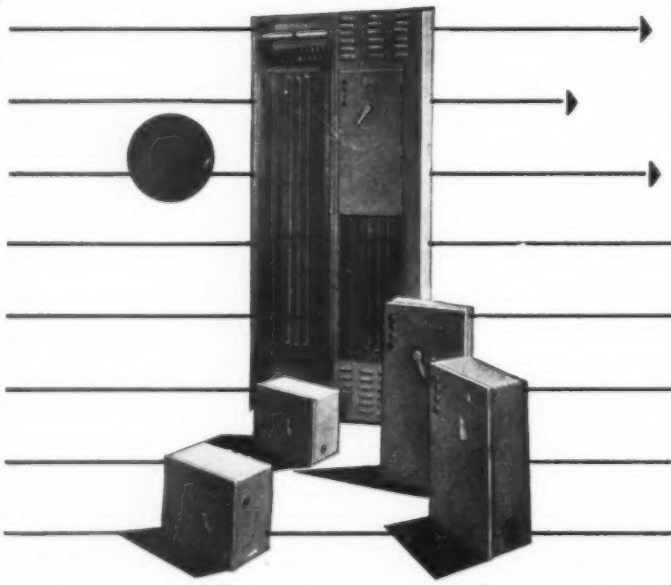
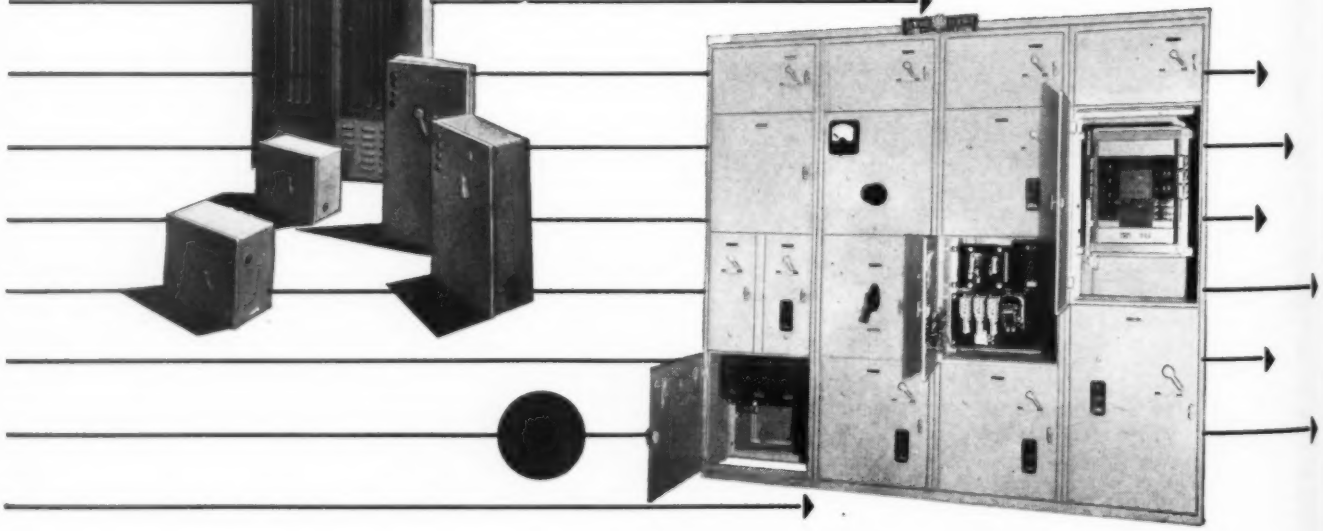








Centralized

short-cut to

	LIMITAMP
Sewage and Water Applications	Pumps, compressors, blowers, conveyors
Voltage	2500 and 5000 v a-c
Horsepower	700 hp at 2300 v; 1250 hp at 4000 v or 4600 v
Motor Type	Any
Starter Type	Full- or reduced-voltage, multi-speed, reversing or non-reversing
Short-circuit Protection	Up to 150,000 kva at 2500 v and 250,000 kva at 4600 v max interrupting rating, current-limiting fuses operate in ¼ cycle; air-break contactors
Mounting	Free-standing; enclosed a-c power bus available for multi-starter lineups
Ask for Bulletin No.	GEA-4247

"Packaged" Control

efficient, attractive plant layout

HEAVY-DUTY LOW-VOLTAGE CONTROLLERS	MOTOR CONTROL CENTERS	CABINETROL
Pumps, compressors, blowers, conveyors	Pumps, compressors, blowers, conveyors, auxiliary equipment, lighting circuits	Complete plant-group control including power-company metering, other meters
600 v a-c, 230 v d-c max	220 to 600 v a-c	220 to 600 v a-c
350 hp d-c, 800 hp a-c max	Up to 100 hp at 440 v	Up to 400 hp at 440 v; or 200 hp at 220 v
Any	Squirrel-cage induction; multi-speed	Any
Full- or reduced-voltage, multi-speed reversing or non-reversing	Combination starters, full-voltage or reactor reduced-voltage, reversing, non-reversing or two-speed	All kinds, including magnetic and electronic
Up to 25,000 or 50,000 amp short-circuit interrupting rating, starters with draw-out air circuit breakers	Up to 25,000 amp interrupting rating; combination starters with air circuit breakers in isolated compartments	Up to 50,000 amp interrupting rating; combination starters with air circuit breakers or fused switches in isolated compartments
Free-standing; enclosed a-c power bus available for multi-starter lineups	Wired or unwired, accessible from front	Free-standing, completely wired, accessible front and rear
GEA-4939	GEA-4979	GEA-3856A

One Of The Above General Electric packaged control equipments can be tailored from standard parts to fill any sewage- or water-plant need. Each is completely metal-enclosed, factory-assembled and tested, and shipped ready to install. To save you installation time and expense, all bus connections, panel wiring, and interconnections can be made at the factory . . . just set the unit in place and hook up incoming and outgoing leads.

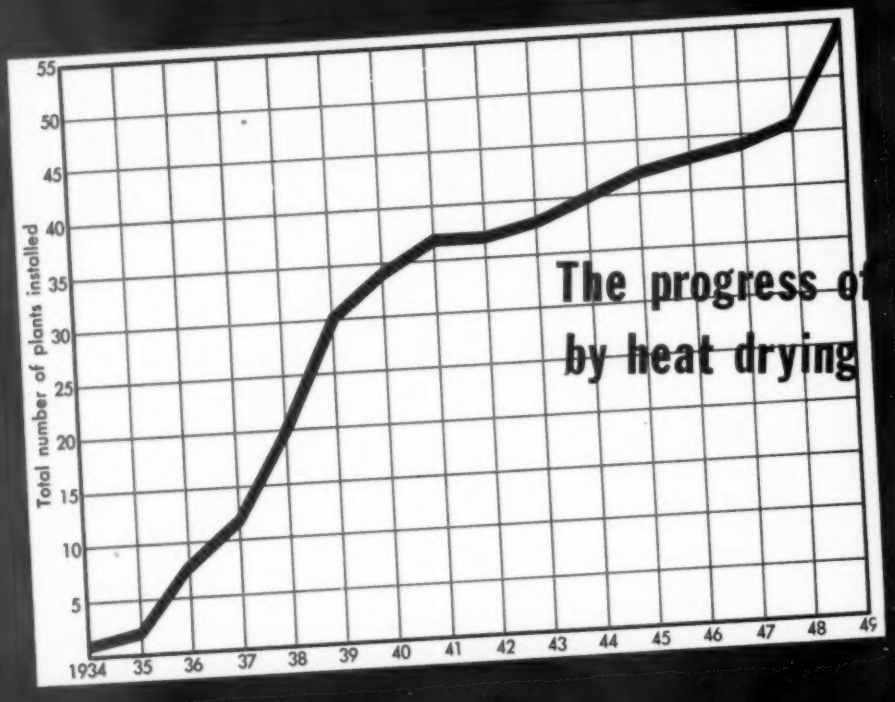
All the above equipments are a standard height to present a uniform, attractive appearance when installed together. Metal enclosures provide greater safety to personnel and equipment.

PLAN EARLY AND PROFIT!

Your consulting engineer or General Electric representative will tell you more about these equipments and help you plan your entire electrical layout. Consult him early, so that you can profit by co-ordinated planning . . . thereby simplifying engineering, buying, construction and installation. Apparatus Dept., General Electric Co., Schenectady, N. Y.

With factories in Anaheim, Los Angeles, Oakland, Ontario, San Francisco, San Jose, Seattle, and Richland, and Sales Offices in twenty Western cities.

GENERAL ELECTRIC



65%

NICHOLS installations

35%

Those of all other Mfrs.

In the overall field of sewage sludge disposal by . . .

incineration to sterile ash
heat drying for fertilizer and
combination drying or incineration . . .

it is worth remembering that 65% of the contracts awarded by municipalities have been to Nichols Engineering & Research Corporation THERE MUST BE A REASON.

We will gladly send you Bulletin No. 201A

Painted for U. S. Pipe & Foundry Co. by Paul Laune

U.S. PIPE

THE quality of U. S. Cast Iron Pipe is controlled to a degree undreamed of by pipe founders a generation ago. Before the molten metal is poured into the mold of a Super-deLavaud centrifugal casting machine the important characteristics of the iron have been determined by our metallurgists. After the pipe has been cast our plant and research laboratories conduct numerous tests, in addition to acceptance tests, to assure the maintenance of quality in U. S. Pipe. This routine procedure at our several plants is enforced so that *we* may be confident that *your* confidence in our product continues to be justified. **United States Pipe and Foundry Co., General Offices: Burlington, New Jersey, Plants and Sales Offices Throughout U. S. A.**

(1) This 101-year-old cast iron water main is serving Frederick, Maryland.

(2) Still in use after 118 years of service in the water supply system of St. Louis, Mo.

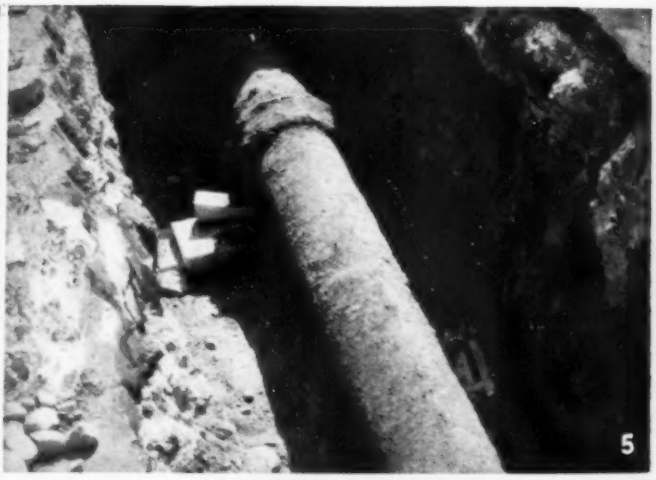
(3) This water main, installed 117 years ago, is still serving Richmond, Va.

(4) Lancaster, Pa. laid this cast iron water main 105 years ago. It is still serving.

(5) One of several cast iron water mains that have been serving New York City for more than a century.

(6) America's oldest cast iron water main, now in its 132nd year of service in Philadelphia.

(7) This cast iron water main has been serving Boston for 120 years.



Going strong in their 2nd Century

About 30 of the older American cities have cast iron water or gas mains in service which were laid from 100 to 132 years ago. Most of these mains, on or after their 100th Anniversary, have been uncovered, inspected and photographed for the record. Seven of them—all water mains, are shown in this advertisement.

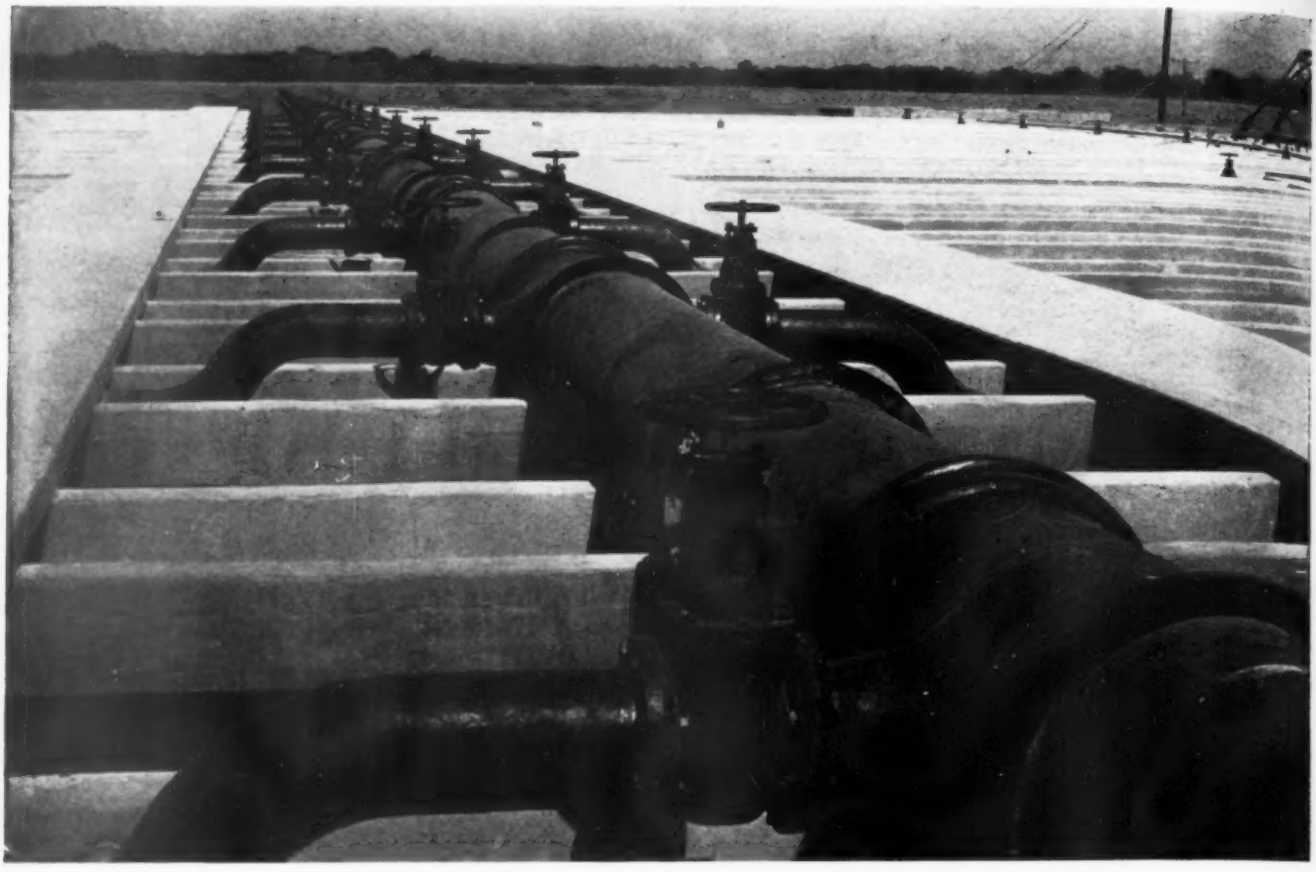
While it is well known that cast iron water mains in England, France and Germany have service records that approach three centuries, we, who make cast iron pipe, nevertheless get a thrill out of looking down into the trench at an uncovered section of a main that has been in service for 100 years—and so, we are told, do water works and gas engineers.

When one considers the radical changes which have occurred in a century in vehicular traffic, and the vast development of underground construction for the many utility services, the fact that these mains are now in their second century of service is all the more remarkable.

CAST IRON PIPE

SERVES FOR CENTURIES

Cast Iron Pipe Research Assn., T. F. Wolfe, Engr., Peoples Gas Bldg., Chicago 3.



24" Mono-Cast Centrifugal Pipe, 24" x 8" Tees and 8" Offsets installed as main air line of sewage treatment works.

MONO-CAST CENTRIFUGAL PIPE

RENDERS QUALITY SERVICE

In Water Works and Sewage Treatment Plants

The feeling of confidence that exists between the Acipco organization and that great body of men responsible for the development of water and sewage works in these United States is the result of many years of close cooperation. Since the beginning of our Company, Acipco has constantly worked hand in hand with engineers, contractors and superintendents in solving piping problems in their respective fields.

As always during the past, Acipco offers quality pipe and fittings plus experienced personal service.

Refer your next piping job to Acipco and utilize both our extensive manufacturing facilities and our nearly half a century of experience in furnishing pipe and fittings for water works and sewage disposal plants.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM 2, ALABAMA

Dallas Houston El Paso Pittsburgh Kansas City New York City
Chicago Minneapolis Cleveland Los Angeles San Francisco Seattle

"Badger Meters are the *best*...when we buy more they will be Badgers"

A waterworks superintendent wrote this, and went on to say: "Our average dead meters for a year was only 7 per month . . . about as low an average as I know of. Your city cannot go wrong buying Badgers".

Millions of satisfied users of Badger Meters in over 5000 communities prove that "It Pays to BUY BADGER" . . . unmatched in precision-construction, durable materials, and sustained accuracy, at lowest operating cost.

ANOTHER NEW Badger Chart, No. 696 (Practical floor plan for a large meter repair shop). Available without cost or obligation. WRITE today for this chart.

BADGER METER MFG. CO., MILWAUKEE 10, WIS.

BRANCH OFFICES:

NEW YORK CITY • PHILADELPHIA • WORCESTER, MASS. SAVANNAH, GA. • CINCINNATI • CHICAGO • KANSAS CITY, MO. • WACO, TEXAS • SALT LAKE CITY, UTAH PORTLAND, ORE. • SEATTLE, WASH. • LOS ANGELES

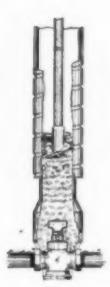
You will find a Badger Meter size and type for every waterworks service. Shown here are Model SC-SOT (for warm climates), and Model A-SOT (for cold climates) . . . sizes 5/8" to 1¼" . . . other models in sizes up to 12". Write for complete information and prices.

BADGER Water METERS

ACCURACY · LOW-COST MAINTENANCE · DURABILITY · SENSITIVENESS

RECONDITION YOUR SERVICE BOXES WITH MUELLER MATERIALS

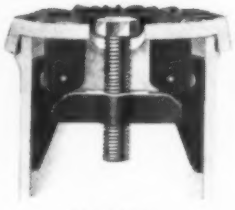
FIRST CLEAN THEM OUT WITH A MUELLER H-10330 CLEANOUT AUGER



THEN FIT THEM WITH NEW MUELLER REPAIR LIDS

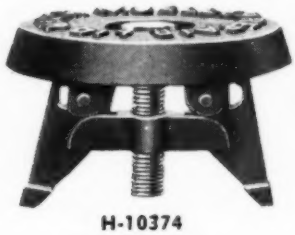
FOR NEW STYLE BUFFALO BOX

H-10373
Size 2½"

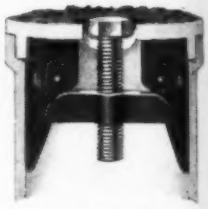


H-10373
Installed

FOR OLD STYLE BUFFALO BOX



H-10374
Sizes 2½", 3"



H-10374
Installed

BECAUSE MUELLER REPAIR LIDS FIT ANY CONDITION

LOST LID

BROKEN LUG

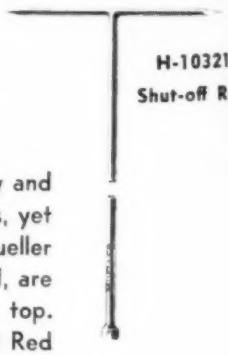
BROKEN TOP

AND CHECK YOUR STOCK OF THESE

H-10323
Malleable Iron
Pentagon Key

H-10325
Cast Steel
Pentagon Key

H-10324
Red Brass
Screw



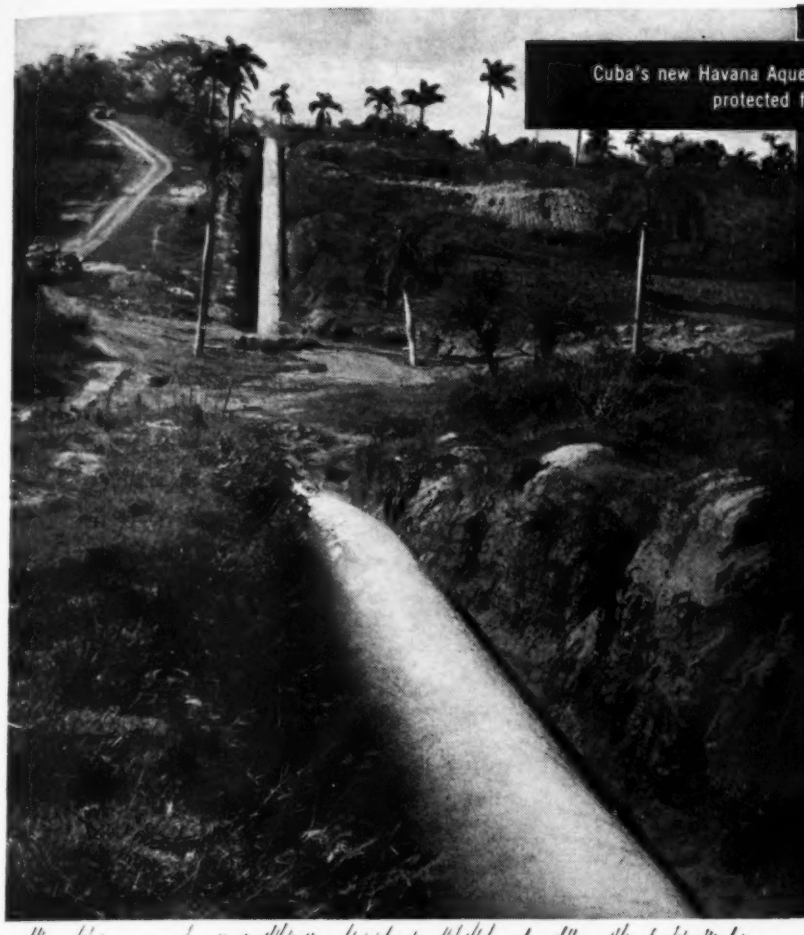
H-10321
Shut-off Rod

Now is the time to recondition those Service Boxes and you can do it easily and economically and actually make them as good as new. The boxes may have broken lugs, broken tops or lost lids, yet any of these conditions are successfully taken care of. Just clean them with the Mueller Service Box Clean-out Auger and attach a Mueller Repair Lid. These lids are easily attached, are practically impossible to pry off and they set flat on the box top. It's also a good idea to check your stock of Pentagon Keys and Red Brass Screws and order at the same time along with Repair Lids.

DEPENDABLE SINCE 1857 FULLY WARRANTED OUR 92nd YEAR

MUELLER CO.

MAIN OFFICE AND FACTORY.....DECATUR, ILLINOIS
OTHER FACTORIES: *Los Angeles, Cal.; Chattanooga, Tenn.; Sarnia, Ont. Canada*



Cuba's new Havana Aqueduct, completely protected from corrosion by Centrilining.

CENTRILINE *protects the new* HAVANA AQUEDUCT

Heavy rains made tractors useless—but Centrilining was completed in record time.

CENTRILINE CORPORATION

140 CEDAR STREET • NEW YORK 6, N. Y.

CEMENT MORTAR LININGS FOR WATER MAINS
CENTRIFUGALLY APPLIED
in strict conformity
with A.W.A.W.A. Specifications

▶▶ HAVANA'S BRAND NEW WELDED-STEEL AQUEDUCT HAS BEEN PERMANENTLY PROTECTED FROM TUBERCULATION AND LEAKAGE BY A THIN, DENSE CEMENT LINING PLACED BY THE CENTRILINE PROCESS.

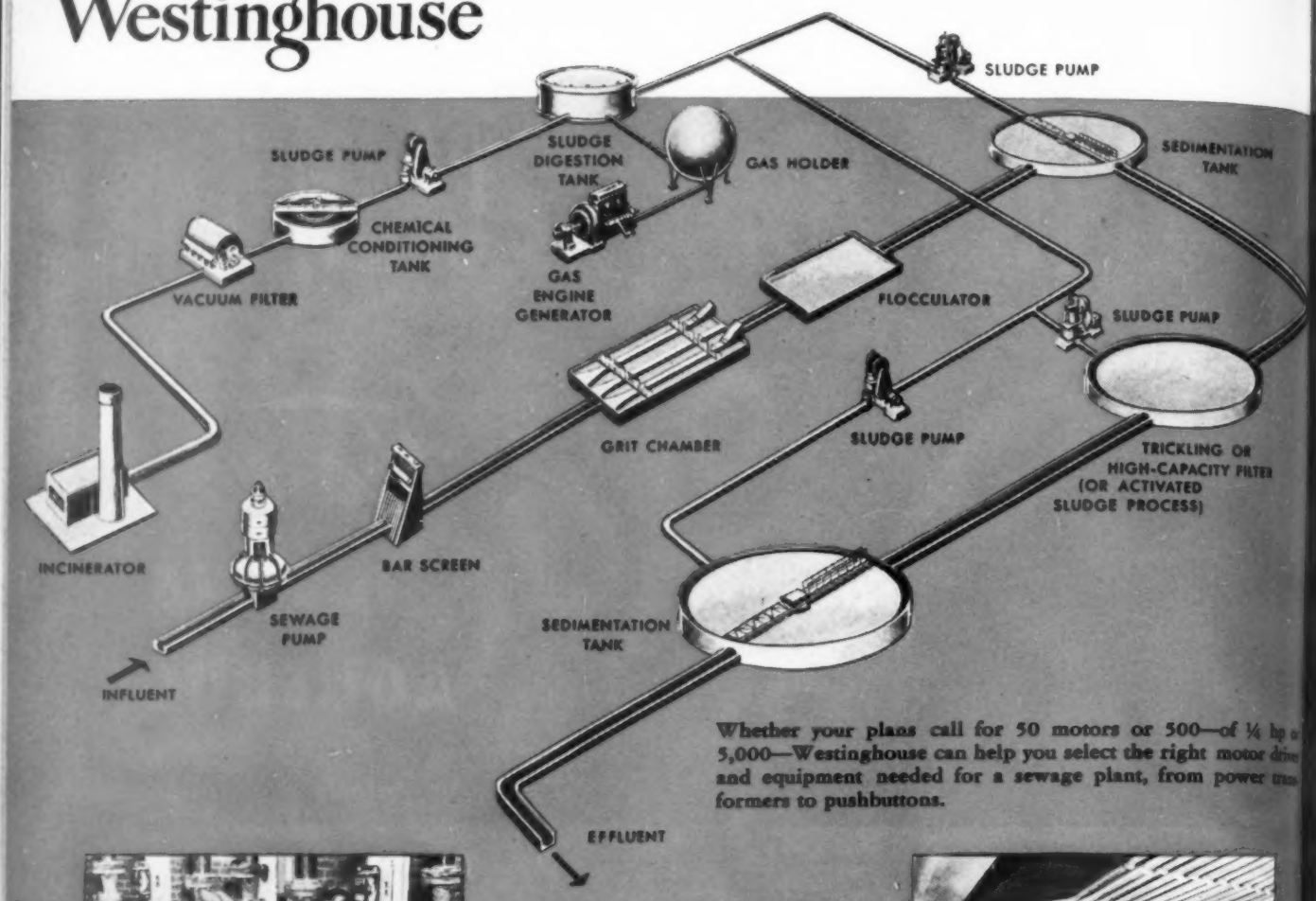
The new pipe line—68″ in diameter and 28,809′ long—was built for the City of Havana by M. A. González del Valle, General Contractor. The steel pipe was fabricated and installed by Compania de Ingenieria Morgran, S. A. of Havana. Because it is a vital link in Havana's new system it was lined in place with centrifugally applied cement mortar.

This protective cement mortar lining will more than pay for itself within a few years through sustained carrying capacity and low pumping costs.

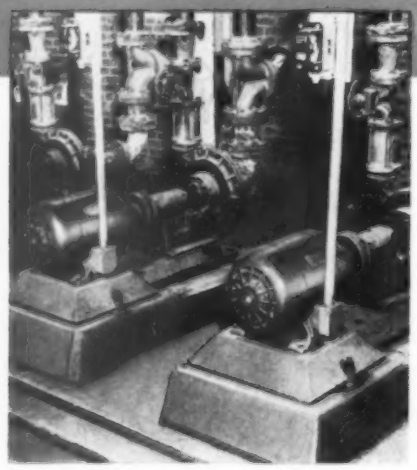
▶▶▶ *Do you want the complete facts on Centrilining? Send for our 28-page illustrated bulletin.*

YOU CAN BE **SURE**.. IF IT'S

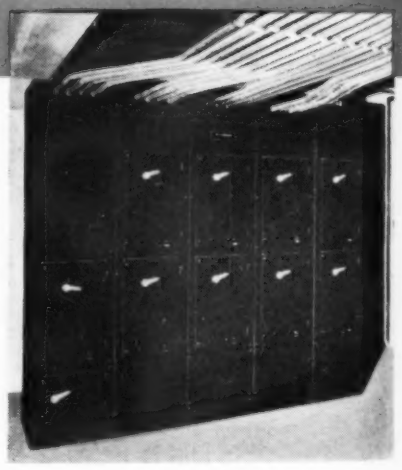
Westinghouse



Whether your plans call for 50 motors or 500—of ¼ hp or 5,000—Westinghouse can help you select the right motor drive and equipment needed for a sewage plant, from power transformers to pushbuttons.

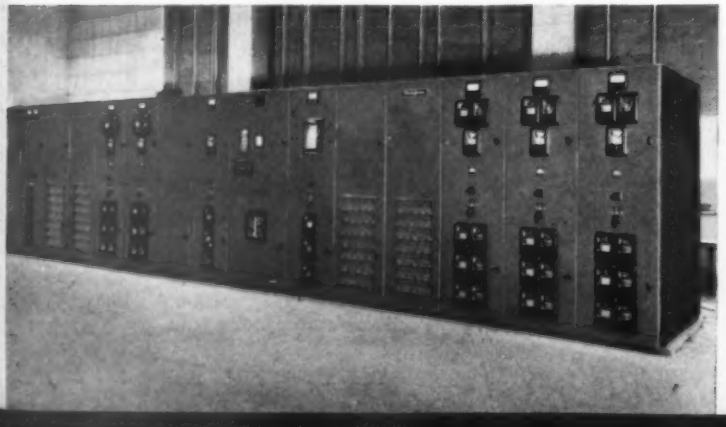


Life-Line motors which need no lubrication being used on a typical pumping application such as encountered in most sewage plants.

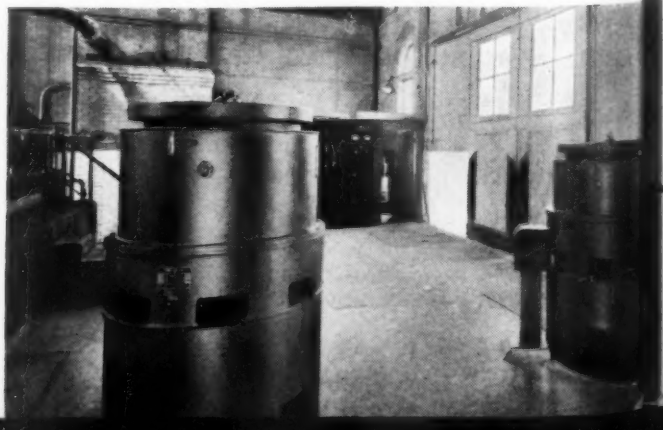


This control center provides a central location for operating all pump, blower and miscellaneous motor drives (600 volts and below) for the surrounding area.

Westinghouse Indoor Metal-clad Switchgear (2,300 volts) for feeder circuits to main pump motors. It's assembled at the factory and installed as a packaged unit to provide protection for vital equipment.



Two Westinghouse Two-speed Vertical CS Motors driving main sewage disposal pumps (one 350/160 and the other 250/100 hp). For emergency conditions, motors have a high-speed rating, can handle 300% of normal capacity.



UNIT ELECTRICAL RESPONSIBILITY

plus practical application help

Satisfactory operation of your sewage plant depends, in a large part, on the electrical equipment which powers and controls its drives. Consider the advantages to you of obtaining all this electrical equipment from one reliable source that will provide you a well co-ordinated, dependable and economical installation based on a practical understanding of sewage plant problems.

Westinghouse provides that source. Our Consulting and Application Engineers have had extensive experience in applying electrical equipment to sewage plants. They will recommend the right equipment for every step in your sewage treating process.

This unit responsibility does not cease with the installation. Our nationwide chain of Manufacturing and Repair Plants and Renewal Parts Warehouses provide you at all times with top-flight maintenance service.

Unit electrical responsibility means economy and efficiency for you. Call your nearest Westinghouse Office or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-94795

WESTINGHOUSE

Westinghouse

Which of these pipe fittings is the right one . . . for this spot?

IF YOU KNOW . . . because you've carefully calculated the temperature, pressure or other service conditions . . . you can get prompt delivery of any of these fittings from a Grinnell warehouse or your local Grinnell jobber.

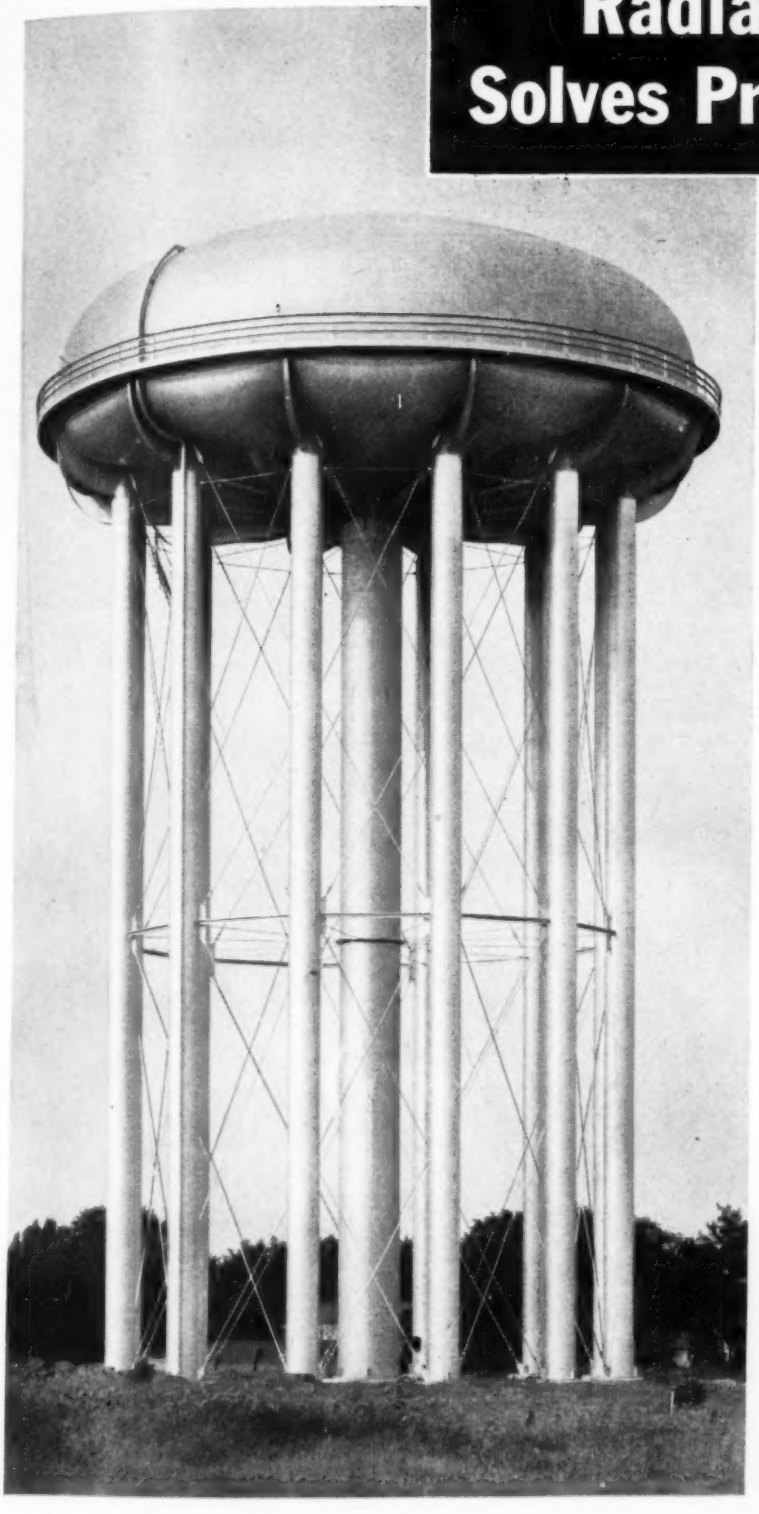
IF YOU'RE NOT SURE . . . because piping can involve so many factors of flow, stress, expansion, contraction and corrosive action . . . you can get the expert guidance of Grinnell engineers. That's a perfect combination . . . Grinnell pipe fittings, Grinnell engineering, Grinnell warehouse service, and Grinnell jobbers in almost every city and town.

99 YEARS PIPING

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branch warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

1,000,000 Gallon Radial-Cone Tank Solves Pressure Problems



At Whitefish Bay

The village of Whitefish Bay, Wisconsin, obtains its water supply from the City of Milwaukee. In the summer, when an abnormal amount of water is used for lawn sprinkling, there had been considerable trouble in maintaining uniform pressures in the village water mains.

As a solution to this problem, the 1,000,000-gal. Horton radial-cone bottom elevated tank, shown at the left, was installed at a location farthest from the point where the water supply enters the village. A recent report on this installation shows that results have been most successful, even during peak demand periods. Because of its location, the Horton tank, supplying the mains by gravity pressure, produces ideal back-feeding—thereby improving pressures in former weak areas.

This is just one example of the way in which municipalities are utilizing Horton radial-cone bottom tanks. Built in capacities from 500,000 to 2,500,000 gals., these modern welded elevated storage tanks provide the answer to better water service for hundreds of similar installations. Learn what Horton tanks can mean to your municipality by contacting our nearest office.

Advantages of *welded* tanks:

1. Joints are water-tight
2. No sharp edges to invite corrosion
3. Easier to inspect and maintain
4. Lower cost
5. Attractive appearance

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Atlanta 3	2181 Healey Building	Detroit 26	1551 Lafayette Building
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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

9 California East Bay Cities Served By Allis-Chalmers

NEW BOOSTER PUMPING STATION IS EQUIPPED WITH A-C SWITCHGEAR, CONTROL PANELS, TRANSFORMERS AND MOTORS

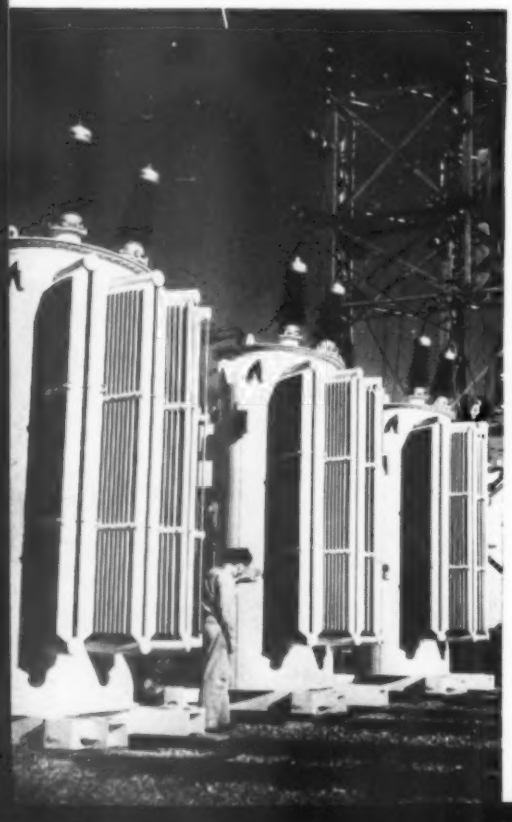
WITHIN EIGHT YEARS, water consumption in the East Bay Municipal Utilities District has increased 134 percent. To meet this rising demand a new booster pumping station was constructed on the 94 mile Mokelumne Aqueduct. Combined with older facilities, this new station more than meets the water demands of the district.

The electrical system of the new station is Allis-Chalmers equipped. A-C equipment here includes a bank of 2000 kva transformers, outdoor metal-clad switchgear, two 4000 hp vertical motors, and a panel and benchboard for the control room. Installed in 1945, this equipment has given efficient, reliable service.

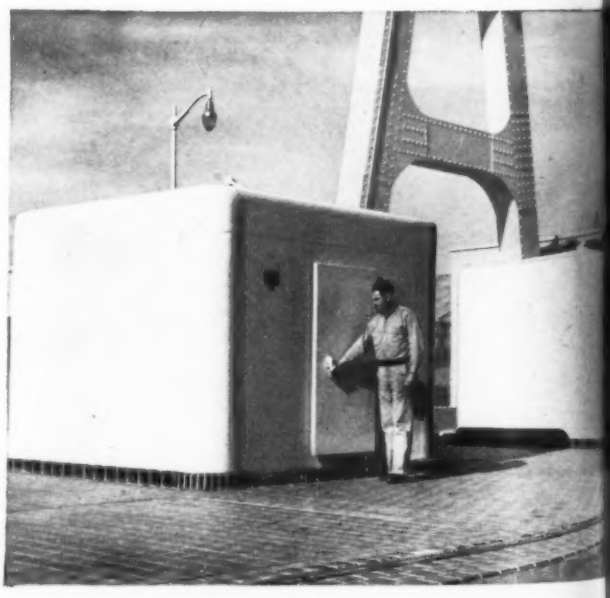
This A-C equipped station is typical of what Allis-Chalmers can do and has done for all size cities—large, medium and small. When your community plans improvements, take advantage of Allis-Chalmers specialized knowledge in building the world's widest range of public works equipment. For more information write for bulletin 25B6607, "Public Works Equipment."

A-2777

ALLIS-CHALMERS, 1192A SO. 70 ST.
MILWAUKEE, WIS.



BANK of Allis-Chalmers single phase, 2000 kva power transformers at new pumping station of East Bay District. Units are equipped with no-load tap changers, side mounted for easy, simple changes. Transformers are also designed with *Oil-Sealed* inert gas systems which seal off cooling oil from outside air. This reduces contamination of cooling oil and prevents deterioration.



4000 HP, 900 RPM vertical motors drive centrifugal pumps. These motors were assembled at the site and enclosed in special weatherproof housings to insure safe outdoor operation. Motors and streamline housings were built by A-C.

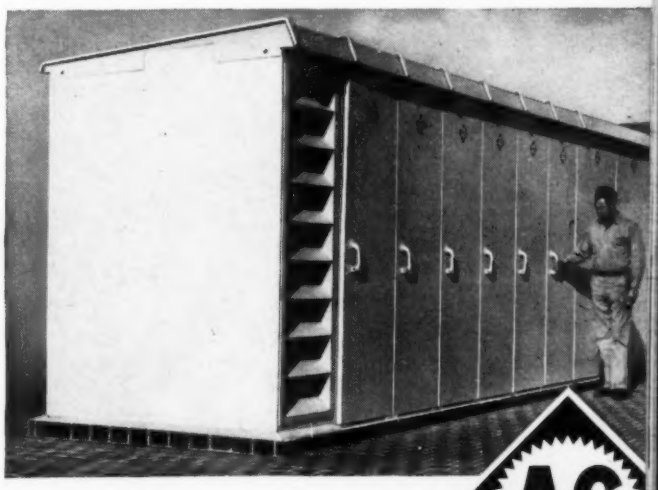
Ruptair and *Oil-Sealed* are Allis-Chalmers trademarks.

AREA SERVED by the East Bay Municipal Utility District includes Alameda, Albany, Berkeley, El Cerrito, Emeryville, Oakland, Piedmont, Richmond and San Leandro. Total area: 187 sq miles with a population of nearly one million. A portion of this area is shown above with Oakland-San Francisco Bay Bridge in the foreground.

Photo by Commercial & Photo View Company, Oakland, Ca

MODERN type control switchboard and benchboard were designed by Allis-Chalmers to provide this station with reliably accurate automatic remote control.

PROTECTION for two 4000 hp motors is provided by outdoor metal-clad switchgear with *Ruptair* magnetic air circuit breakers rated 100,000 kva interrupting capacity.



ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Builders of the World's Widest Range of Public Works Equipment

HERE ARE ALL THE FEATURES YOU'RE LOOKING FOR

THE CYLINDRICAL PLUG of an a.c.f. type valve needs no lifting from a tapered seat:

- Quick operation, if needed
- A quarter turn—full flow
- A quarter turn—full shut-off
- Straight-through flow—most desirable
- *Round* full pipe area port*—no restriction
- No exposed seats when on flow—no abrasion
- Lubricated—for long life and corrosion protection.

*Can be supplied in rectangular port with full area.

CYLINDRICAL FULL PIPE AREA LUBRICATED

a.c.f. PLUG VALVES

Representatives in more than 50 principal cities.

Ideal for sewage operations. Ask for catalog 4-WS. American Car and Foundry Company, Valve Division, 30 Church St., New York 8, New York.

It's no fun answering consumer complaints . . . that is why many water works engineers have found it a wise precaution to apply small amounts of Aqua Nuchar Activated Carbon continuously. In this way, when algae, trade wastes or decaying vegetation cause a sudden increase in tastes and odors, it is only necessary to apply larger dosages of Aqua Nuchar to bring the condition under control immediately.

The sterilization of water supplies with chlorine has been almost universally adopted as a means of making water *safe* for human consumption; and since the first successful application of Aqua Nuchar in water supplies almost two decades ago, it is possible to deliver a *palatable* as well as *safe* water to consumers.

Purification experts from our Technical Service Department are available, at no cost or obligation, to study your taste and odor problems.

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OTHER PRODUCTS: *Snow Top Precipitated Calcium Carbonate* • *Nuchar Activated Carbons* • *Liqro Crude Tall Oil* • *Indusoil Distilled Tall Oil* *Tallene Tall Oil Pitch* • *Tallex Abietic Acid* • *Sulfate Wood Turpentine* • *Alpha Pinene* • *Beta Pinene* • *Polycel Cellulose Fibers* • *Indulin (lignin)*

"Hey, Joe! Did you ever see a $100 bolt?"

JOE: "What d'ya mean, a hundred-dollar bolt?"

GUS: "Just what I said. We're raising Number 3 Gate just now and this anchor bolt let go."

JOE: "But we put that gate in less than two years ago, and..."

GUS: "Yeah, I know. But we used ordinary bolts and this one's already rusted through. It'll cost at least a hundred bucks to take that gate out, dig the old bolt out of the concrete and set a new one in."

JOE: "I guess it will. But from here out we don't make that mistake twice. From now on everything that goes in is Everdur."

Most sewage and waterworks engineers have discovered that the most economical way to lick the corrosion problem in their plants is to use Everdur*—ANACONDA's copper-silicon group of alloys. There are plants where equipment made of Everdur has been doing it for over 22 years.

If you don't already know about Everdur, let us tell you about its high strength, durability and how easy it is to fabricate it into lightweight, low-cost wrought assemblies. Just ask for the Everdur booklets. Let our Technical Department counsel you on any special problems or applications. Write to The American Brass Company, Waterbury 88, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

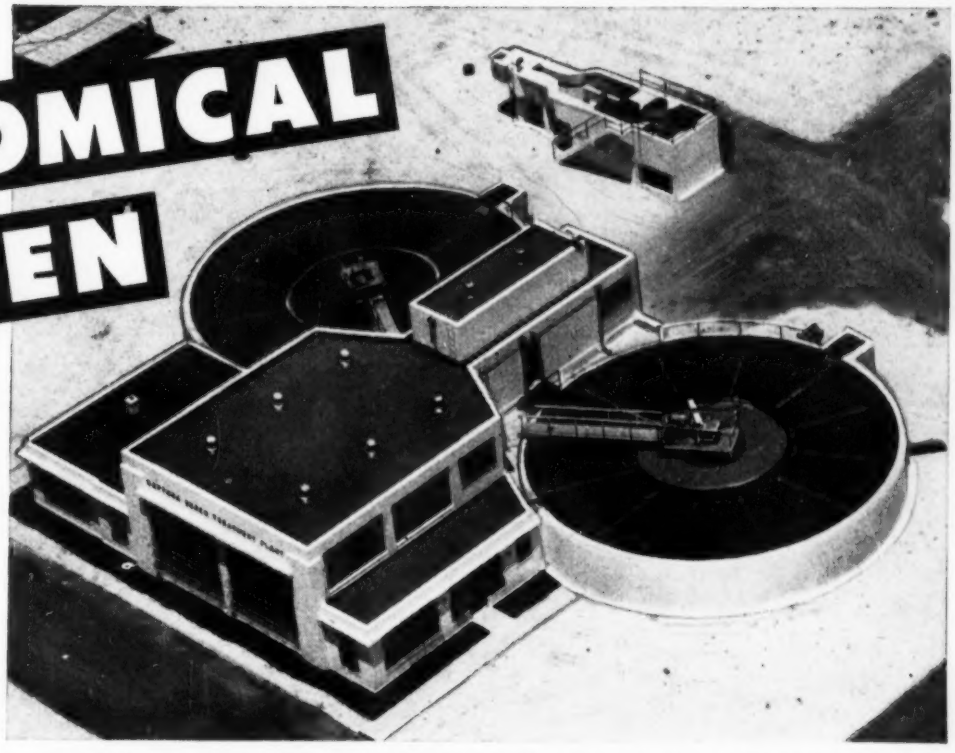
Where corrosion resistance counts—use Everdur

ANACONDA copper-silicon alloys

*Reg. U. S. Pat. Off.

ECONOMICAL PROVEN NEW

CHEMICAL AND BIOLOGICAL SOLUTIONS TO WASTE TREATMENT



ORIGINAL INSTALLATION OF THE INFILCO "DAYTONA BEACH PROCESS" AT DAYTONA BEACH, FLORIDA, WHERE THE EFFICIENCY AND ECONOMY OF THIS TREATMENT METHOD IS BEING DEMONSTRATED IN EVERY DAY USE.

TWO remarkable adaptations of the ACCELATOR® are now available for the treatment of many wastes by either chemical or biological methods, or by varying combinations of the two.

Thoroughly tested in laboratory and pilot plant studies . . proved out in actual use . . these remarkably simple yet effective methods may provide the waste treatment answer you have long sought.

*THE INFILCO "DAYTONA BEACH PROCESS" . . *for the clarification and treatment of oil refinery wastes, organic wastes, and domestic sewages.*

Using a Sewage Accelator with Vorti-Mix Aeration, this method of waste treatment is based upon the ability of water softening plant sludge (or other similar material) to remove oils, greases and other colloidal organic matter.

*AERO-ACCELATOR . . *for high rate "activated slurry" biological treatment of food processing wastes, other organic wastes, and domestic sewages.*

The AERO-ACCELATOR with Vorti-Mix Aerator incorporates intensive aeration with Accelator type circulation for rapid biological action. Incoming sewage or liquid waste is immediately dispersed along with oxygen or air throughout the entire mass of "activated slurry". Retention time is much less than in conventional biological treatment methods.

*AERO-ACCELATOR combined with the INFILCO "DAYTONA BEACH PROCESS" . . *for biological—chemical treatment where shock loads of incoming wastes of varying organic composition are frequent.*

When an AERO-ACCELATOR with Vorti-Mix Aerator is used with the addition of a small amount of calcium carbonate or softening plant sludge to weight the "activated slurry", the combined biological-chemical approach gives better separation of clarified liquid and a more compact sludge. Consequently shock loads may be handled with less possibility of upsetting the treatment process.

✻ ***While you are at the Convention (October 17-20), drop in at our Booth. We'll be pleased to explain in more detail about these latest developments in waste treatment. There will also be information on other types of INFILCO equipment and processes of importance to all concerned with sewage works planning and operation.***

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

INFILCO INC.

GENERAL OFFICES: 325 WEST 25th PLACE • CHICAGO 16, ILLINOIS

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

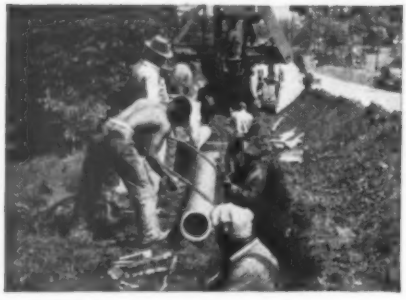
WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

Here's how TRANSITE PRESSURE PIPE meets these 7 basic water-line problems . . .

IF YOU are faced with some—or all—of these 7 common water-line problems, here is information about Johns-Manville Transite* Pressure Pipe that may be of help to you . . . facts that tell how this modern asbestos-cement pipe is helping to solve these problems in many communities.

1. Handling costs:

Because it is light in weight and easy to handle, Transite Pressure Pipe keeps handling costs down. Loading, unloading, and all other subsequent handling operations are simplified. More footage can be hauled per truck-load—reducing trucking costs—and distribution along the trench is easier and more quickly accomplished. Moreover, mechanical handling equipment is not necessary except where larger sizes are being used; the pipe sections are easily lowered into the trench with rope slings.



2. Installation costs:

Transite Pressure Pipe offers important economies that help combat increasing costs of water-line installation. It is quickly and easily assembled in the trench. A coupling puller is the only tool necessary. Often, the pipe can be assembled so rapidly that the same foreman supervises both excavation and installation. The speed with which Transite is assembled means that the job is completed with a minimum of time and labor, thereby contributing important reductions in the overall cost of the system.

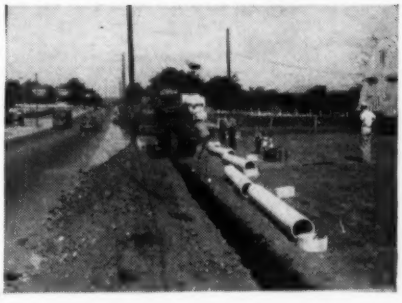
*Transite is a Johns-Manville registered trade mark

3. Soil corrosion:

Two factors give Transite Pressure Pipe exceptional resistance to corrosion: (1) the corrosion-resistant materials of which it is made; (2) the especially developed Johns-Manville process of manufacture which imparts a high degree of chemical stability to the finished pipe. This high resistance to corrosion has been substantiated by numerous installations. Many of these are serving as replacements in soils so destructive that the useful life of the pipe materials previously used had been seriously curtailed.

4. Internal corrosion:

Transite Pipe, because of its asbestos-cement composition, is not affected by tuberculation. Therefore, it is not necessary to resort to pipe of larger diameter to offset the internal effects of this costly form of pipe corrosion. And because progressive reduction of delivery due to tuberculation capacity is never a problem in a Transite pipe line, pressures and flows remain high—pumps operate at higher efficiencies. These factors are often reflected in better service and lower water rates in communities served by Transite lines.



5. Joint leakage:

Transite's Simplex Coupling was designed to minimize underground leakage . . . and to provide maximum protection against failures resulting from trouble at joints. It consists of only three parts: a Transite sleeve, machined to fit over the pipe ends, and two rubber rings which, when assembled, are tightly compressed between pipe and sleeve. The joint thus formed is tight and flexible. It remains tight in service. Furthermore, each joint may be checked for proper assembly immediately upon completion.

6. Vibration and stresses:

Transite's flexible joints effectively absorb the vibration of heavy traffic—an especially important factor where pipe is laid under busy highways, or near railroad and street car tracks. Because each joint is capable of deflection up to five degrees, the entire line has a flexibility not ordinarily found in other types of waterline construction. This helps compensate for soil movements and other stresses to which the pipe may be subjected . . . provides an effective safeguard against costly pipe failures.

7. Maintenance:

In thousands of communities, Transite Pipe—with its advantages of joints that remain tight and flexible, its corrosion resistance, and immunity to tuberculation—provides low-cost water transportation that requires little, if any, maintenance. Transite lines do not have to be cleaned, lined, or replaced because tuberculation has reduced their original capacity. Reports from communities all over the country prove that Transite's asbestos-cement structure provides economies that continue through the years.

If you would like additional information about Transite Pressure Pipe, write to Johns-Manville, Box 290, New York 16, N.Y. Ask for Brochure TR-11A.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville Transite Pressure Pipe

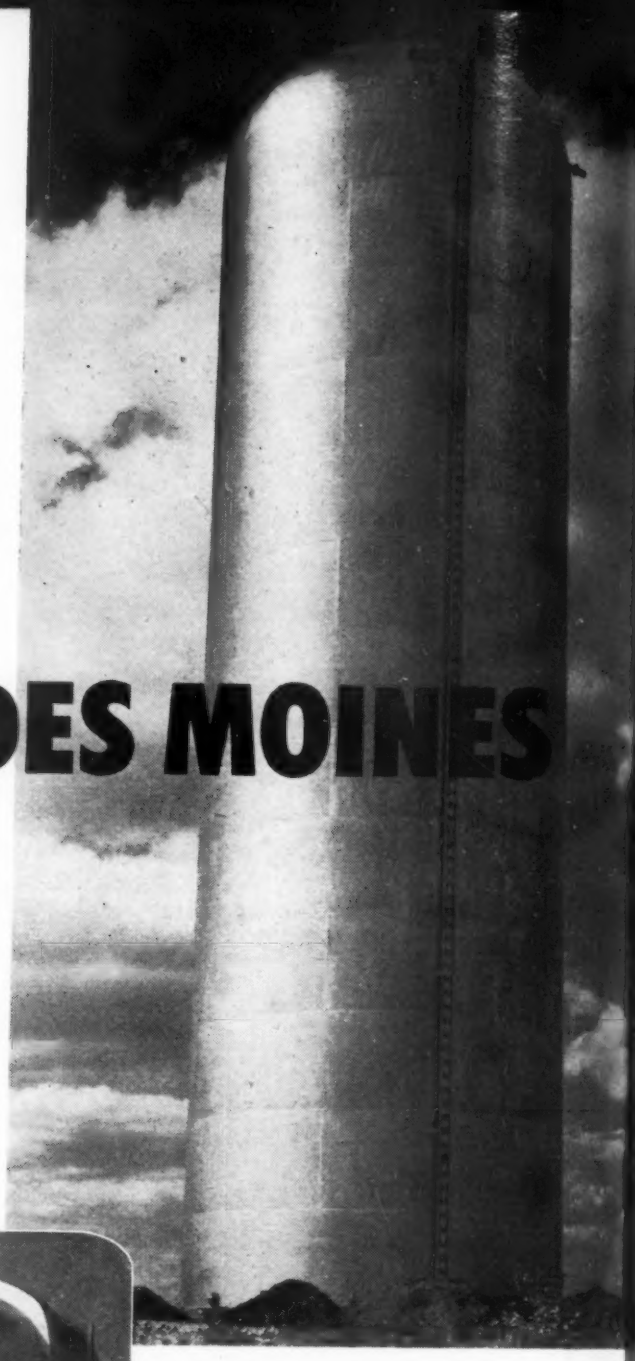
FOR ECONOMICAL

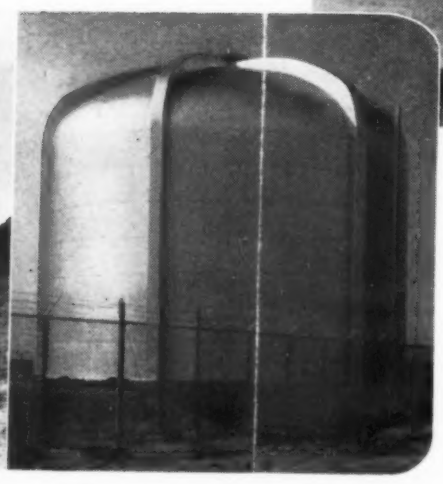
Water Storage

AT NATURAL ELEVATIONS

PITTSBURGH·DES MOINES

Standpipes and Reservoirs





Sound, enduring performance, based on correct engineering, dependable fabrication and careful erection, assures complete satisfaction with Pittsburgh-Des Moines Steel Standpipes and Reservoirs.

Over the years, their first-cost economy, low maintenance, and continued freedom from deterioration make these units an ideal water storage investment. *Write!*

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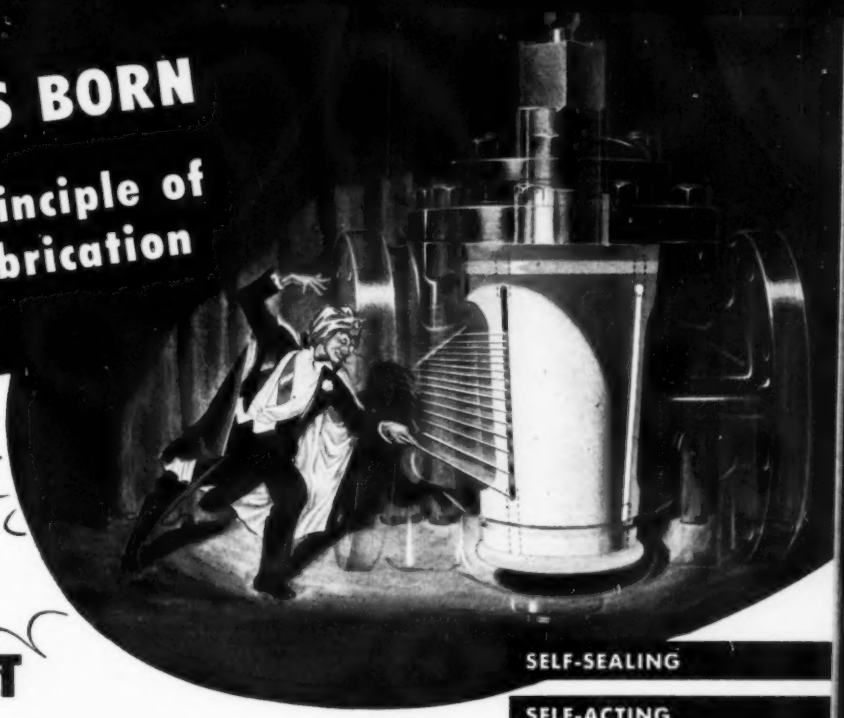
A miracle IS BORN

an astounding new principle of NORDSTROM VALVE lubrication



AN energizable LUBRICANT

- SELF-SEALING
- SELF-ACTING
- SELF-THINKING
- CONTINUOUS PRESSURE
- SPLIT-SECOND ACTION
- MAN-HOURS SAVED
- TWICE THE STORAGE
- MULTIPLIED VALVE LIFE
- GALLING ELIMINATED
- SAVES LUBRICANT

to seal Nordstrom valves automatically and continuously

Fully automatic lubrication for Nordstrom valves is here! Introduction of Rockwell *Hypermatic* lubricant marks the greatest advancement in the valve industry since the invention of Nordstrom valves 30 years ago. Hypermatic is the first and only genuine automatic lubricant. Now you can cut your valve maintenance cost because your lubrication crew need devote only 1/10, 1/20, 1/50, up to 1/100 as much time to re-lubrication. Your Nordstrom valves will give better service with less cost because each one will be automatically maintained in a condition of 100% lubrication, even in event of considerable neglect.

Leakage will be prevented because Hypermatic both seals and lubricates with split-second action and positive certainty. Almost twice as much Hypermatic can be compressed into the valve's lubricant chambers, permitting increased storage.

NOTHING TO BUY EXCEPT THE LUBRICANT—Instead of resorting to the use of extraneous devices or endeavoring to use variable line pressure, Hypermatic provides a new system of lubrication which gives the effect of a vastly improved valve design. You don't have to invest a single cent in mechanical devices. You don't even have to purge the old lubricant. Simply switch to Hypermatic and apply it to your present Nordstrom valves.

Your Nordstrom valves will use less Hypermatic than non-automatic lubricant.

ROCKWELL **Hypermatic** TRADE MARK **LUBRICANT**

Patents applied for

FOR NORDSTROM VALVES

IT COMPRESSES

Like the action of a door-check, Hypermatic compresses to a fraction of its volume when lubricant is energized.

IT EXPANDS

When the valve needs lubricant to seal a leak, Hypermatic expands and seals the valve seat. It feeds into any void instantly.

AUTOMATIC LUBRICATION

Greatest improvement in history of Nordstrom valves
—gives effect of improved design without mechanical change
Tried, tested, proved in laboratory, field and plant
Keeps Nordstrom valves in state of perfect lubrication

NORDSTROM VALVE DIVISION—*ROCKWELL MANUFACTURING CO.*
400 North Lexington Avenue • Pittsburgh 8, Pennsylvania
Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses • Export: Rockwell International Corp., 7701 Empire State Building, New York 1, New York

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Place your order immediately for this new, amazing automatic lubricant. A variety of types is available.

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For dependable
8-minute softening use the
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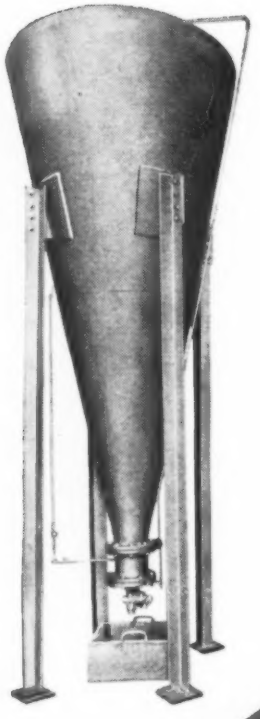
Permutit has added new speed to lime treatment. The Spiractor softens water twenty times faster than old style methods and takes up far less space!

FAST but SURE!



The Spirator is sturdy and dependable, operates simply, and requires a minimum of maintenance. Raw water mixed with lime enters at the base of the cone at a velocity high enough to suspend a catalyst bed of calcium carbonate granules, low enough to avoid carry-over. The water softening reaction results in precipitates that are deposited on these granules by accretion. Enlarged granules are drawn off through valve in base—and disposed of as easily as moist sand grains. No messy sludge to get rid of! The softened water, clear and low in alkalinity, is ready for suitable filtration.

Write for details to The Permutit Company, Dept. W-10, 330 West 42nd Street, New York 18, N. Y., or to The Permutit Company of Canada, Ltd., Montreal.

Permutit

For over 35 Years Water Conditioning Headquarters

Experienced Water Works men know it pays to use products made by

RENSSELAER

VALVES & HYDRANTS IN STOCK
ATLANTA
CHICAGO
KANSAS CITY
LOS ANGELES

...for instance

SLEEVES AND VALVES FOR *Tapping* AND REPAIR

There are many good makes of tapping and repair equipment available today. But there's only ONE line with the name RENSSELAER behind it — and that means a lot to experienced users. It means CERTAINTY of rugged construction, no breakdowns on the job. It means LASTINGLY watertight sleeve joints with heavy lead gaskets full sleeve length. It means that bolts WON'T TURN in bottom half of Rensselaer sleeves while nuts are being tightened — a big help on the job.

And it means l-o-n-g sleeves for greater support, plus a neater job of centering the sleeve, better caulking and saving of lead, (thanks to the raised lead-rings inside). Yes, it always pays to buy under the name Rensselaer, the name backed by over 65 years of experience. Why not call in a Rensselaer Representative today?

LEADERSHIP FOR OVER 65 YEARS

RENSSELAER

Gate Valves • Square Bottom Valves • Tapping Valves and Sleeves
Hydrants • Check Valves • Air Release Valves

RENSSELAER VALVE COMPANY • TROY, N. Y.

Division of Neptune Meter Company

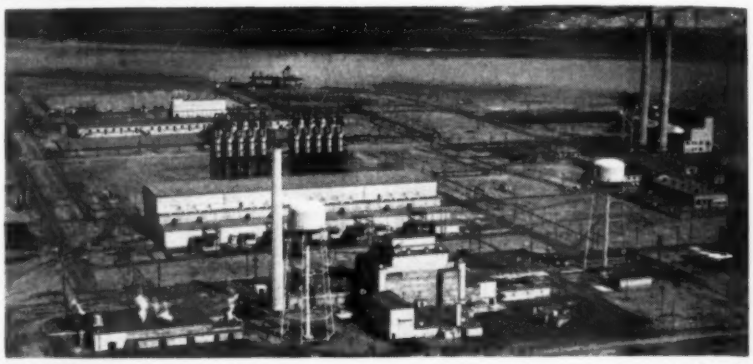
Atlanta, Bala-Cynwyd, Pa., Chicago, Denver, Haverhill, Mass., Hornell, N. Y., Kansas City, Los Angeles, Memphis, Oklahoma City, Pittsburgh, San Francisco, Seattle, Waco

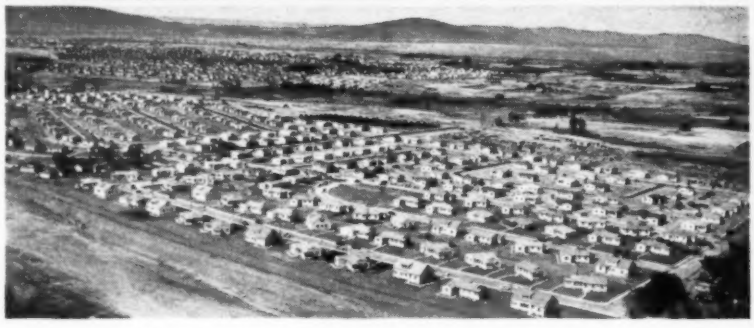
YOU'LL *ALWAYS* FIND

VITRIFIED CLAY PIPE

"WHERE THE SERVICE IS TOUGHEST"

THAT'S WHY HALF A MILLION FEET OF CLAY PIPE IS SPECIFIED FOR "TOUGH SERVICE" AT THE VAST HANFORD ATOMIC ENERGY EXPANSION PROJECT . . . .





THIS half-billion-dollar Hanford atomic energy plant and Richland, Washington, its operating city of 25,000, constitute the largest peacetime construction project in the history of the United States. Planned and directed by engineers and consultants of Dupont de Nemours and General Electric Companies, both plant and city are sewered and drained *throughout* by Vitrified Clay Pipe. Pipe sizes range all the way from 4" house connections to huge 36" pipe for storm drainage. Photos show the Hanford Engineer Works, its city of operating personnel, and some of the "acres" of Vitrified Clay Pipe used in the project.

NO EXCEPTIONS MADE ON CLAY PIPE'S LIFE SERVICE

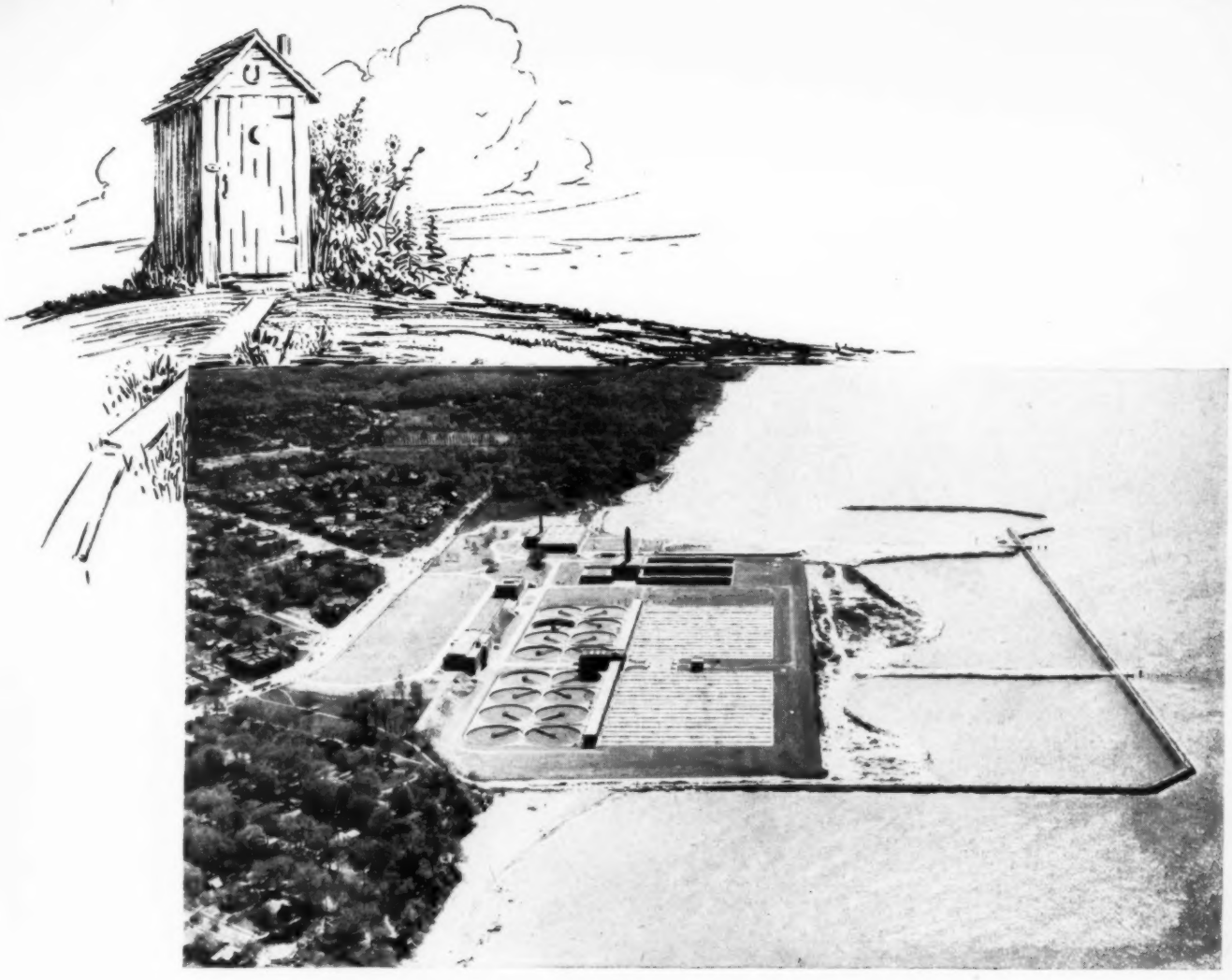
Pure, blended clays are heat-bonded by vitrification into strong, acid-proof Clay Pipe that NEVER WEARS OUT, even under the "toughest" sewerage or drainage conditions. Clay Pipe is the pipe for long-lasting, trouble-free service . . . *anywhere!*

NATIONAL CLAY PIPE MANUFACTURERS, INC.

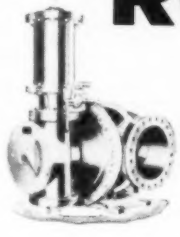
703 Ninth and Hill Bldg., Los Angeles 15, Calif.
1105 Huntington Bank Bldg., Columbus 15, Ohio
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
522 First National Bank Bldg., Atlanta 3, Ga.

C-349-1

Vitrified CLAY PIPE



NOW MODERN Disposal Plants *WITH* ROTOVALVES *IN SERVICE*



LEADING in design and construction to meet peoples' needs, prominent engineers have turned, in ever-increasing numbers, to Rotovalves by Smith. For here is a cone valve in which the plug lifts, rotates and seats itself; which provides minimum loss, and gives positive, quick action. Obtainable in a complete line of sizes, with either manual, hydraulic or motor control, for *stop* and *check service* for Sewage and general Sanitation needs. *Shipment from stock.* Send for full data pertaining to your *own* problem!

S. MORGAN SMITH Co.

YORK, PENNA. U.S.A.

A VALUABLE BOOK FOR *Your* DESK

Here's a new book you'll want to keep within easy reach. The Rex Sanitation and Process Equipment Bulletin is packed with helpful information for anyone working with the problem of removing solids from liquids—in both municipal and industrial fields. Here are detailed discussions of general principles . . . plans and sectional views of equipment and installations . . . specifications . . . data on auxiliary equipment . . . suggestions for special uses and industries . . . a table of useful conversion factors.

Yes, you'll want Bulletin 48-41 at your finger tips to help you plan your installations and select the right equipment. Write for your free copy today. Address Chain Belt Company, 1610 West Bruce Street, Milwaukee 4, Wis.

CHAIN BELT REX COMPANY — SANITATION EQUIPMENT

...and that is saving money for the citizens of Fairbury

In a relatively small community like Fairbury, Nebraska, the municipal Water Department is acutely aware of the interests of the citizens—and the citizens are closely interested in the costs of the Water Department.

Fairbury adopted Threshold Treatment with Calgon in 1940 because of trouble with scale in distribution lines and in home heaters. As usual, this treatment quickly cleaned up the trouble. There has been no scale trouble in the lines, and local plumbers state that heaters now last considerably longer than before Calgon treatment was installed.

The Water Department pleased water users—but also got an "extra dividend" they hadn't counted on. Meter repairs decreased so greatly that the annual savings *in replacement parts alone* more than covers the cost of the Calgon. Labor costs, too, are less, for two men now handle the work which used to keep three busy.

Fairbury is only one of many hundred communities of all sizes where Threshold Treatment with Calgon is used to prevent scale, control corrosion, eliminate "red water" or stabilize water following lime softening.

Calgon representatives will be glad to discuss the use of Threshold Treatment in your plant.

**T.M. Reg. U.S. Pat. Off.*

HAGAN HALL BUROMIN CALGON

calgon, inc.

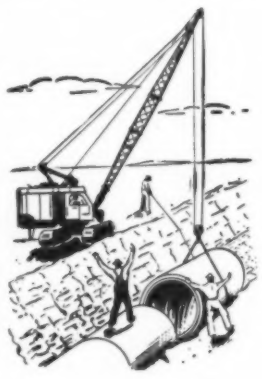
A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PA.

48½ Miles of *CONCRETE PIPE* in New Tulsa-Spavinaw Water Line

WHEN TULSA NEEDED expanded water line facilities to serve growing domestic and industrial needs it selected concrete pipe for the installation. This new line, extending northeast from Tulsa to Spavinaw Creek, uses 48½ miles of 72-in. and 66-in. concrete pipe. It is designed to deliver 40 mgd.

This new water line parallels a 25 mgd. concrete pipe line *that Tulsa built to Spavinaw Creek 25 years ago.* The satisfactory performance of that line was an important influencing factor in drawing up the specifications for this second line.



With both installations, Tulsa will benefit from water lines that will:

—serve without tuberculation and have far less incrustation to impair their hydraulic efficiency.

—prevent leakage because of their dense structure and joints that can be made watertight.

—stay clean, thus minimizing taste, odor and dirty water difficulties.

—have the durability to render long years of service.

—require little or no maintenance expense.

—provide true *low-annual-cost* service.

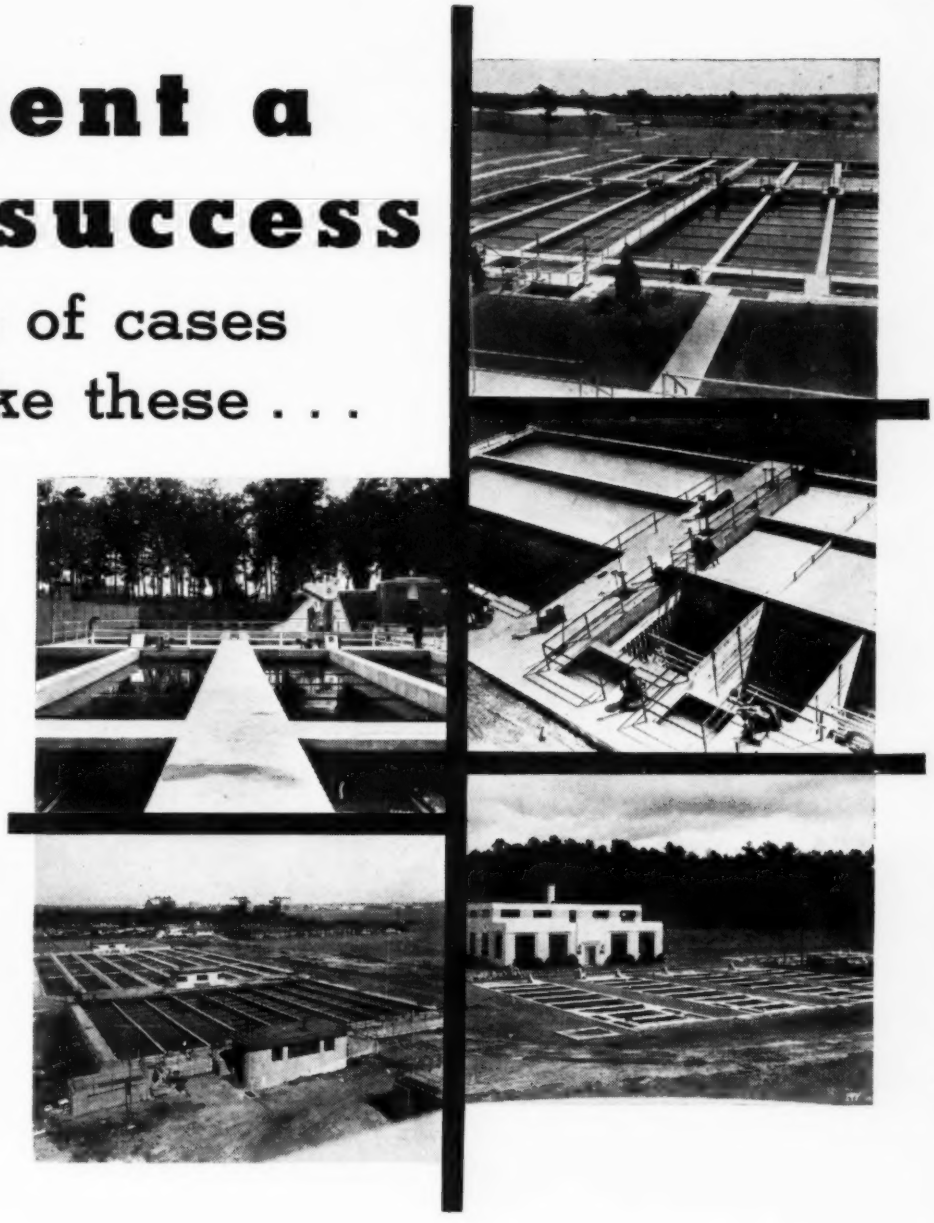
PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

treatment a success

in hundreds of cases like these . . .



Five Jeffrey-equipped treatment plants are shown here. They include towns and cities serving populations ranging from 1500 to several million. Find out about Jeffrey Collectors, Bar Screens, FLOCTROLS, Grit Washers, Sludge Elevators, Scum Removers, Chemical Feeders, Screenings Grinders, etc.

When you really want to correct your ills you go to a specialist. That is just good sense. Many cities with growing pains have called in Jeffrey, M D (Mechanically-Designed) for equipment to treat water and sewage effectively. Jeffrey Sanitation Engineers are specialists. You can turn your problem over to them with full confidence for it's a TREAT TO GET GOOD TREATMENT.

JEFFREY

ESTABLISHED 1877

JM

SALES OFFICES IN PRINCIPAL CITIES

THE JEFFREY MANUFACTURING COMPANY 996 NORTH FOURTH STREET, COLUMBUS, OHIO

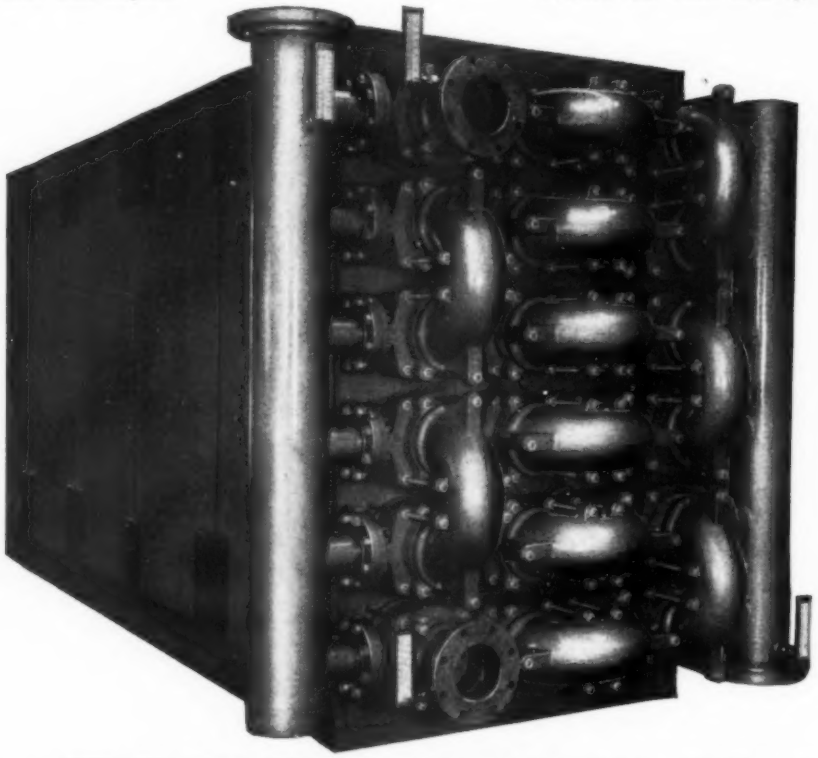
F.S.W.A. Conventioneers---

See the P.F.T. HEAT EXCHANGERS

BEING INSTALLED AT BOSTON'S NUT ISLAND SEWAGE TREATMENT WORKS

Boston, famed for its baked beans and cod, will be better known among sewage plant officials and civil engineers for its modern Nut Island Sewage Treatment Works. We urge those attending the F.S.W.A. Convention in Boston to visit this plant and inspect the two No. 641 P.F.T. Heat Exchangers being installed. Their combined capacity will more than satisfy the maximum design digester heating load of 6,600,000 B.t.u. per hour. Operating in parallel the P.F.T. units heat sludge to a temperature that ideally accelerates the digestion process. Four 110' diameter digesters, two of which are equipped with P.F.T. Floating Covers, are served by the P.F.T. Heat Exchangers.

Engine jacket water from five sewage sludge gas engines is circulated through 8" diameter tubes within which are 6" diameter sludge tubes which provide ample passageway, quick pick-up and sufficient sludge recirculation capacity. Three of the engines are coupled to generators providing power for pumps and other equipment, and two engines drive blowers used for aeration. The utilization of engine jacket water to control the temperature of the sludge effects worthwhile economies. The use of P.F.T. Heat Exchangers to control sludge temperature eliminates the troubles encountered in circulating hot water through coils in the digestion tank. Boston joins the many other cities now using modern P.F.T. Heaters and Heat Exchangers.



P.F.T. PACIFIC FLUSH TANK CO.

SEWAGE TREATMENT EQUIPMENT EXCLUSIVELY SINCE 1893

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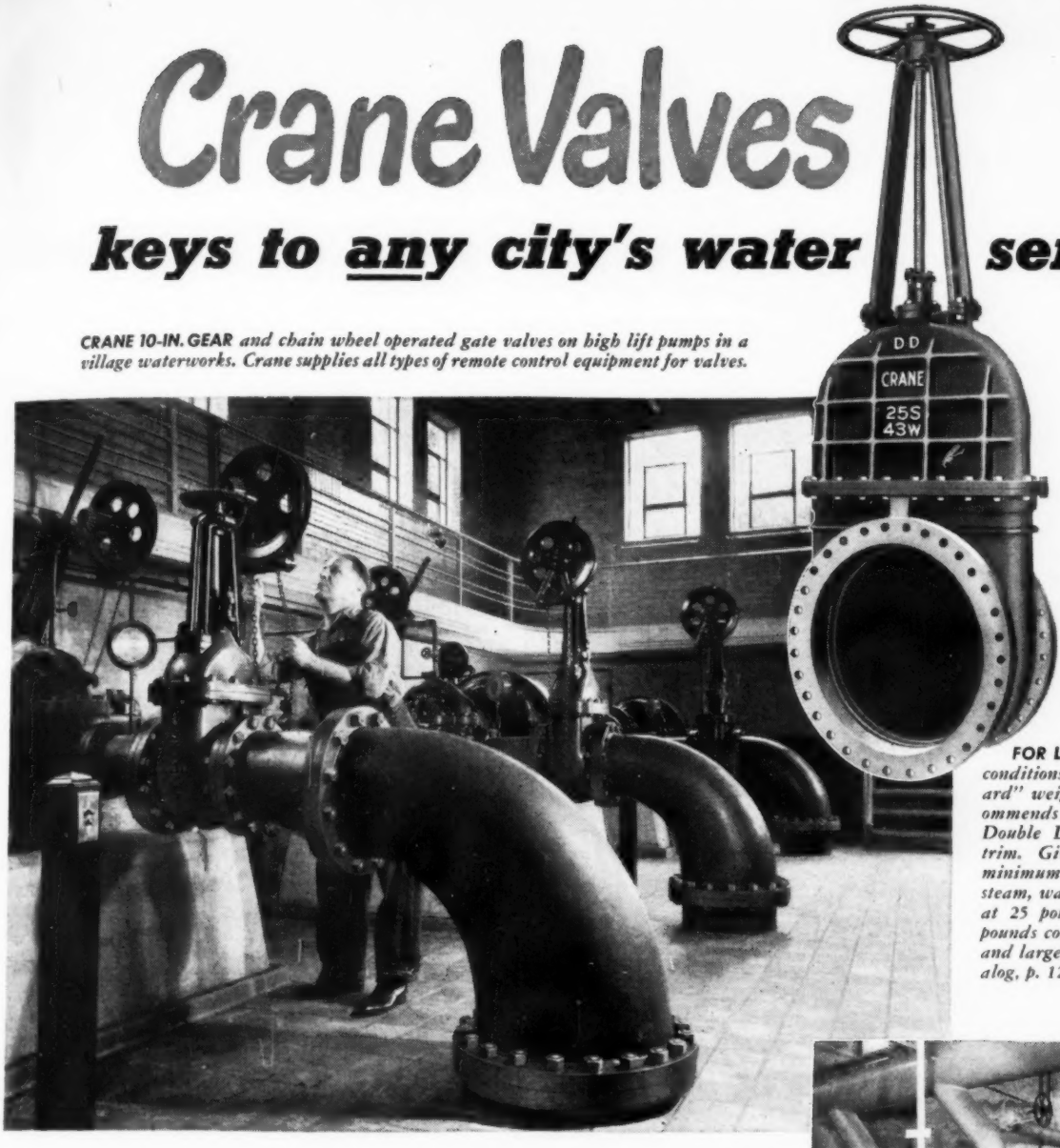
NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • DENVER • TORONTO

Crane Valves

keys to any city's water services



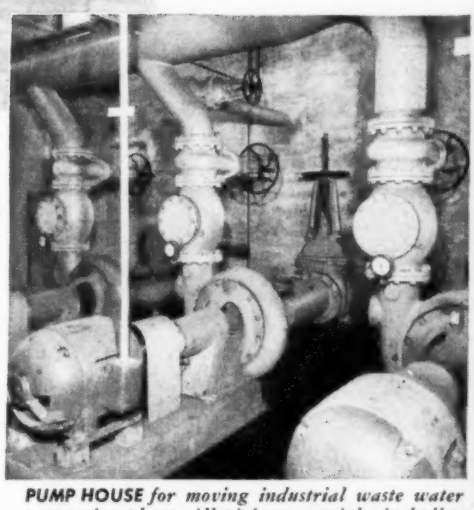
CRANE 10-IN. GEAR *and chain wheel operated gate valves on high lift pumps in a village waterworks. Crane supplies all types of remote control equipment for valves.*

FOR LOW PRESSURE SERVICE *conditions not requiring "standard" weight valves—Crane recommends No. 793½ Iron Body Double Disc Gates with brass trim. Give excellent service at minimum cost on low pressure steam, water or gas lines. Rated at 25 pounds steam, up to 50 pounds cold water. Sizes: 10 in. and larger. See your Crane Catalog, p. 122-3.*

In mill town or metropolis . . . in water supply or sewage disposal plants . . . in short, wherever flow control equipment guards public health, you find Crane valves. Why? Simply because their performance record, established under all operating conditions, warrants it.

Since the beginning of modern flow control methods, Crane valves have shared in the steady development of the nation's public water services. And today, Crane Quality is *still* your best value for valves that give dependable service with minimum maintenance and replacement costs.

CRANE CO., 836 South Michigan Ave., Chicago 5, Ill.
Nation-wide Service Through Branches and Wholesalers

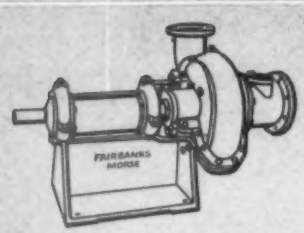


PUMP HOUSE *for moving industrial waste water to treating plant. All piping materials, including shop fabricated manifold, gate and check valves, are Crane.*

VALVES · FITTINGS · PIPE

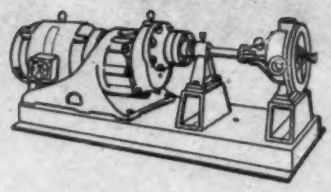
CRANE

PLUMBING AND HEATING

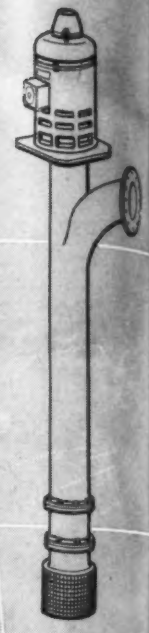


Paper Stock Pumps

Frame Constructed Rotary Pumps

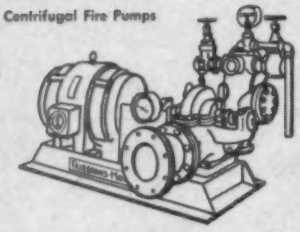


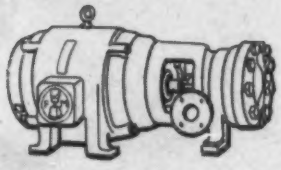
Rotary Pumps with Geared Head Motor Drive



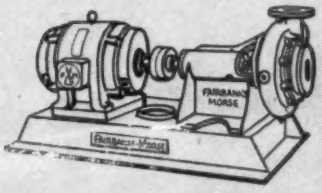
Vertical Propeller Pumps

Centrifugal Fire Pumps

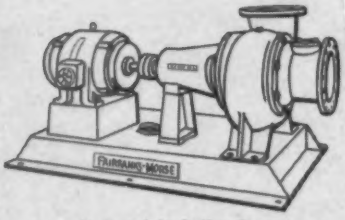




Two-Stage Builtogether Pumps



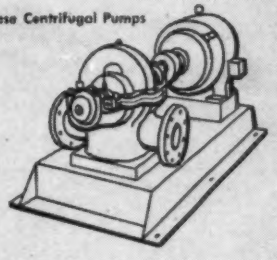
Horizontal Sewage and Trash Pumps

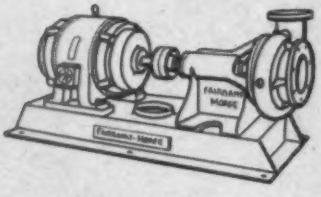


Horizontal Angle Flow Pumps

Vertical Close-Coupled Sewage and Trash Pumps

Split-Case Centrifugal Pumps

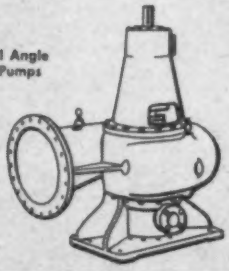


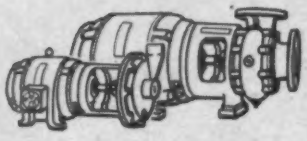


Base-Mounted Centrifugal Pumps

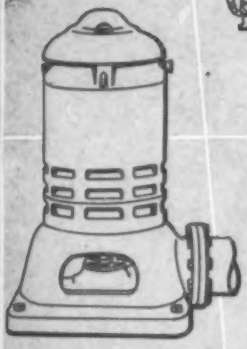
Vertical Sewage and Trash Pumps

Vertical Angle Flow Pumps

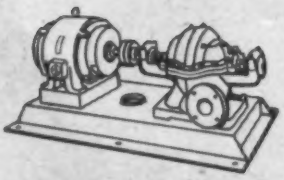




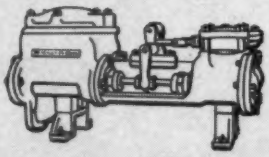
Builtogether Centrifugal Pumps



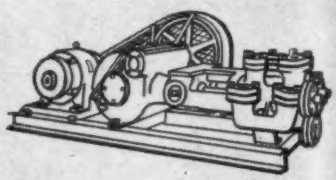
Deep Well Turbine Pumps



Two-Stage Centrifugal Pumps



Duplex Steam Pumps



8 Cover Side-Pot Duplex Power Pumps

for Pumps...

THAT DELIVER

plus performance
lasting dependability
unsurpassed economy

The Fairbanks-Morse Pump Dealer is your best bet for assistance in pump selection...for reliable service. Fairbanks, Morse & Co., Chicago 5, Ill.

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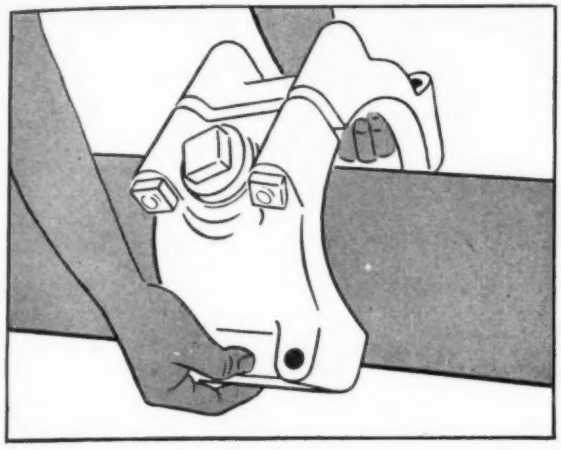
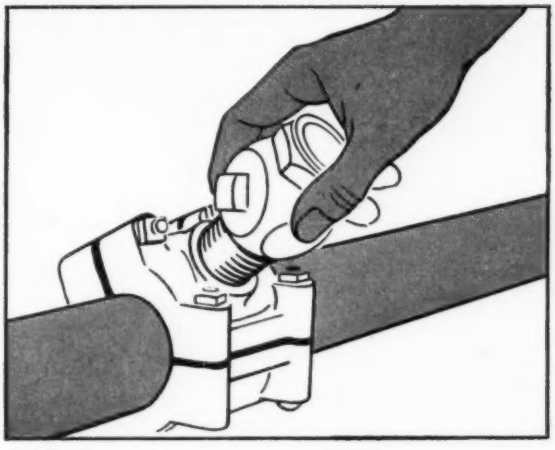
A name worth remembering

DIESEL LOCOMOTIVES • DIESEL ENGINES • PUMPS • SCALES
MOTORS • GENERATORS • STOKERS • RAILROAD MOTOR CARS
and STANDPIPES • FARM EQUIPMENT • MAGNETOS

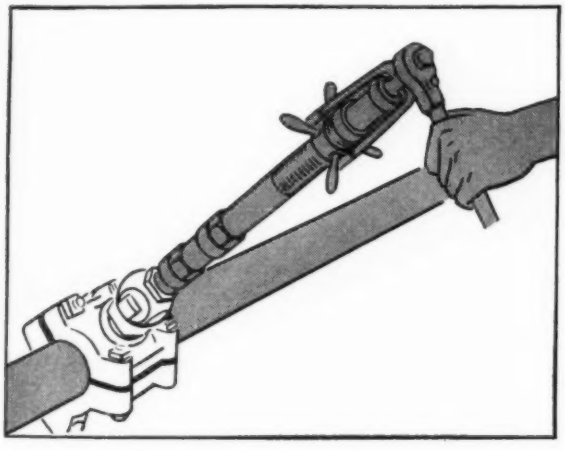
EASY WAY TO MAKE A 2" tap on a 4" main



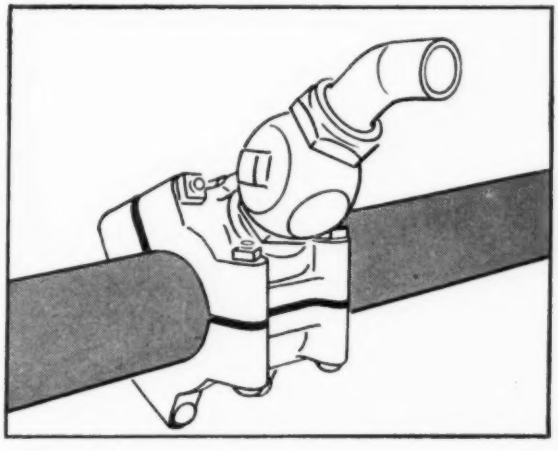
1. ***Fit Dresser Style 82 Sleeve on the pipe.*** This low-cost sleeve is easily installed, requires no caulking, is permanently bottle-tight.



2. ***Insert 2" corporation stop*** in the threaded vent of the sleeve. (Vented sleeve section furnished with corporation tap if specified.)



3. ***Drill pipe with tapping machine*** conventionally used for drilling through corporation stops.



4. ***Run Service*** according to your usual practice. Rubber packed sleeve assures lifetime flexibility at the main.

This method permits tapping a main under pressure, and is vastly simpler than siamesing several small taps together. It provides flexibility, eliminates the use of several corporation stops and requires only one drilling operation. Save time, save money—make all your larger taps with Dresser "Adjustable" Sleeves. *Write today for literature and prices.*

DRESSER "ADJUSTABLE" SLEEVES

Dresser Manufacturing Division, 59 Fisher Ave., Bradford, Pa. (One of the Dresser Industries) • In Texas: 1121 Rothwell St., Houston
In Canada: 629 Adelaide St., W., Toronto, Ont. • Sales offices: New York, Chicago, Houston, San Francisco

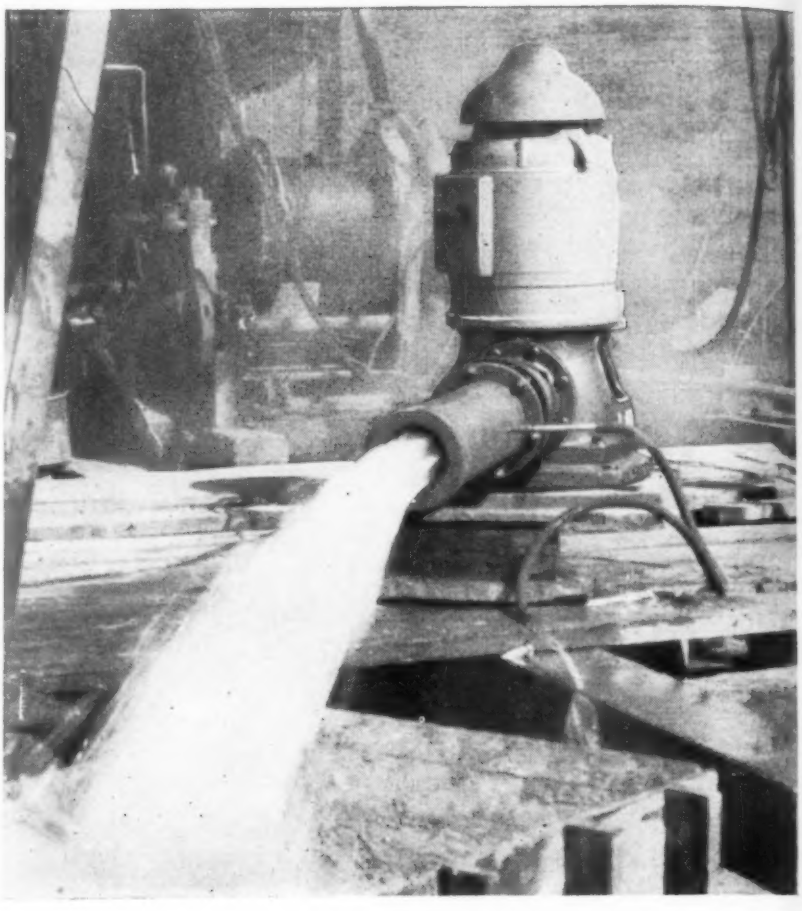
WHAT'S TO BE GAINED BY MAKING COMPARISONS

THERE IS NO BETTER YARDSTICK

COMPARISON is a fair yardstick in buying any well water system. That is why Layne welcomes and urges comparison with any and all other systems now being built. Comparisons quickly reveal the superiority of Layne designing as reflected by higher overall efficiency, better materials and low upkeep cost, plus extra rugged construction insuring longer life.

In addition there is the all important matter of proper installation. Leading engineers of the country readily admit that Layne installation methods are better. They provide well water systems with increased capacity and keep operation cost surprisingly low.

The choice of a Layne Well Water System is a wise and profitable selection. Thousands of big, medium and small installations are giving economical and satisfactory service today and will continue to do so for many years.



Vertical Turbine PUMPS

—are available in sizes from 40 to 16,000 gallons per minute and may be used in already constructed wells, for irrigation, pressure boosting, fire control or transfer services. Write for pump catalog.

BUILT TO ADEQUATELY FULFILL YOUR WATER SUPPLY NEEDS

Each Layne Well Water System is designed and installed to supply requirements without overburdening. Usually there is a surplus capacity to care for future increased demands or unforeseen emergencies. Always there is available on short notice the services of trained and properly equipped Layne personnel for any contingency.

For catalogs, bulletins or further information, address the general offices.

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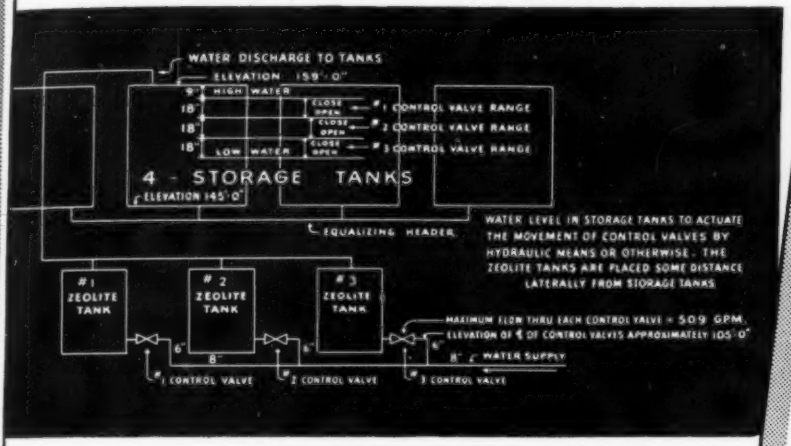
GENERAL OFFICES, MEMPHIS 8, TENN.

WELL WATER SYSTEMS

ASSOCIATED COMPANIES—Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Pacific, Inc., Seattle, Wash. ★ The Layne-Texas Co. Ltd., Houston, Tex. ★ Layne-Western Co., Kansas City, Mo. ★ Layne Minnesota Co., Minneapolis, Minn. ★ International Water Corp., Pittsburgh, Pa. ★ International Water Supply, Ltd., London, Ont. ★ Layne-Hispano Americana, S.A., Mexico, D. F. ★ General Filter Company, Ames, Iowa.

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •


WATER DISCHARGE TO TANKS
ELEVATION 159'-0"
HIGH WATER
LOW WATER
1 CONTROL VALVE RANGE
2 CONTROL VALVE RANGE
3 CONTROL VALVE RANGE
4 - STORAGE TANKS
ELEVATION 145'-0"
EQUALIZING HEADER
WATER LEVEL IN STORAGE TANKS TO ACTUATE THE MOVEMENT OF CONTROL VALVES BY HYDRAULIC MEANS OR OTHERWISE. THE ZEOLITE TANKS ARE PLACED SOME DISTANCE LATERALLY FROM STORAGE TANKS
#1 ZEOLITE TANK
#2 ZEOLITE TANK
#3 ZEOLITE TANK
MAXIMUM FLOW THRU EACH CONTROL VALVE = 509 GPM.
ELEVATION OF ℄ OF CONTROL VALVES APPROXIMATELY 105'-0"
WATER SUPPLY
1 CONTROL VALVE
2 CONTROL VALVE
3 CONTROL VALVE

Automatic Control of Treated Water

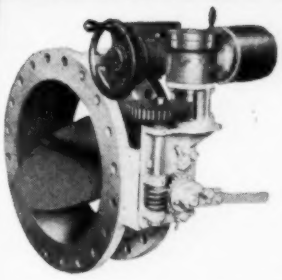
In the above installation, float switches control the three electric motor operated slow acting R-S Valves which maintain a constant supply of treated water in the four storage tanks. The result is simplified performance, minimum pressure drop, unexcelled flow characteristics and reduced maintenance.

Similar applications of power operated R-S Valves can be equipped with air diaphragm, oil or hydraulic cylinders for the control and shut-off of a multitude of materials. They are used advantageously to reduce, regulate and shut off pressure whether above or below atmosphere; to control liquid level; to relieve and control back pressure; to maintain a constant differential pressure; to control rate of flow; to control combustion, and govern the output of pumps, fans, engines and turbines.

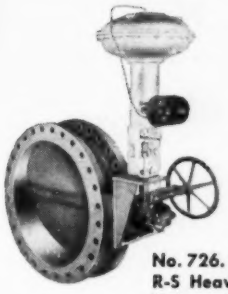
R-S Valves are precision engineered, metallurgically and mechanically. Adapted to elevated or sub-zero temperatures . . . 15 to 900 psi.

Consult with your local R-S representative. Look for the address and phone number listed under "R-S Products Corporation, Valves" or write direct.

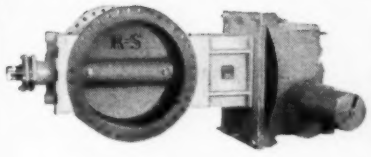
R-S PRODUCTS CORPORATION
Wayne Junction • Philadelphia 44, Pa.



No. 617. Float Switch Electric Motor Control for slow acting R-S Valve. Hand wheel for manual operation on gear reduction drive. Extended lever for operating sister valve in parallel line.



No. 726. 30-inch R-S Heavy Duty Valve with 125-pound American Standard flanges, steel diaphragm top and positioner, hand wheel control with declutching mechanism and outboard gooseneck bearing on operating shaft.



No. 658. 42-inch R-S Heavy Duty "H" Metal 125-pound Valve for high pressure and flow. Opens or closes completely in one second requiring 38,000 pounds torque.

No. 755. R-S Pipe Line Shock Absorbers (four models) eliminate shock and hammering in pipe lines carrying liquids of any nature. No moving parts . . . easily installed in any position.

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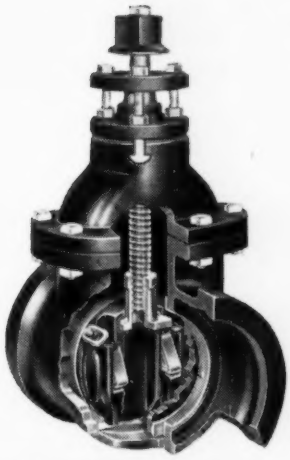
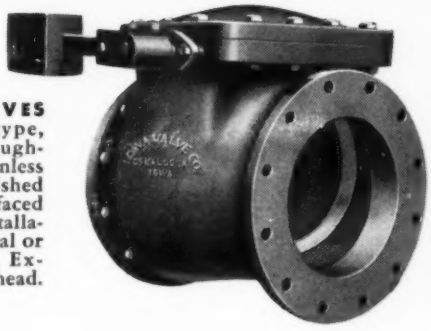
Superiority of Design, Workmanship, and Materials Assures Efficient Trouble Free Operation . . .

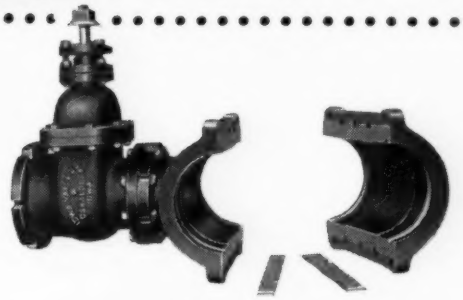
In every job



IOWA GATE VALVES—Simple, rugged construction, fully bronze mounted. Parallel seat, double disc type with independent solid bronze wedges and stem nut. Trouble free service assured.

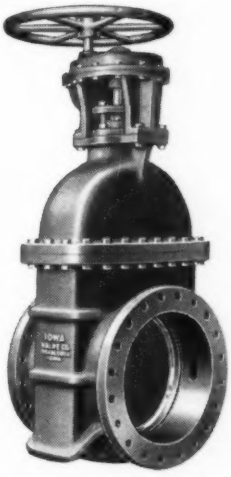


IOWA CHECK VALVES—Balanced swing type, bronze trimmed throughout. Equipped with stainless steel hinge pin. Furnished with rubber or leather faced disc if desired. For installation in either horizontal or vertical pipe lines. Extremely low loss of head.

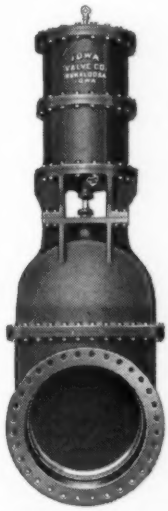


IOWA TAPPING SLEEVES and VALVES—Sturdily built, easy to assemble and center on pipe. All bolted type with lead strips for tight sleeve connections. Extra long body sleeves with heavy flanges amply protect the cut. All sizes available.

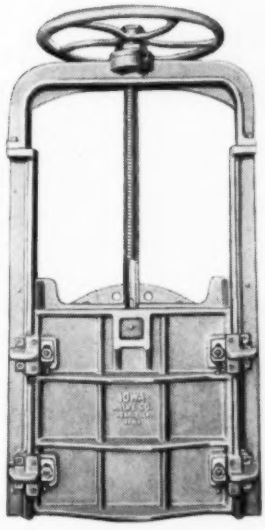
IOWA FIRE HYDRANTS—Latest Corey type conforming to AWWA specifications. Will not geyser when standpipe is broken. Unique design provides unrestricted water flow with extreme low loss of head.



IOWA SQUARE BOTTOM VALVES—Specially designed for throttling service in filter wash and pump discharge lines. Square bottom features can be built into gate valves of any pressure ratings.



IOWA HYDRAULIC VALVES—Superiority of design matched with sturdy construction meets severe, continuous filter service requirements. Available with either iron, brass lined or brass tubing cylinders.



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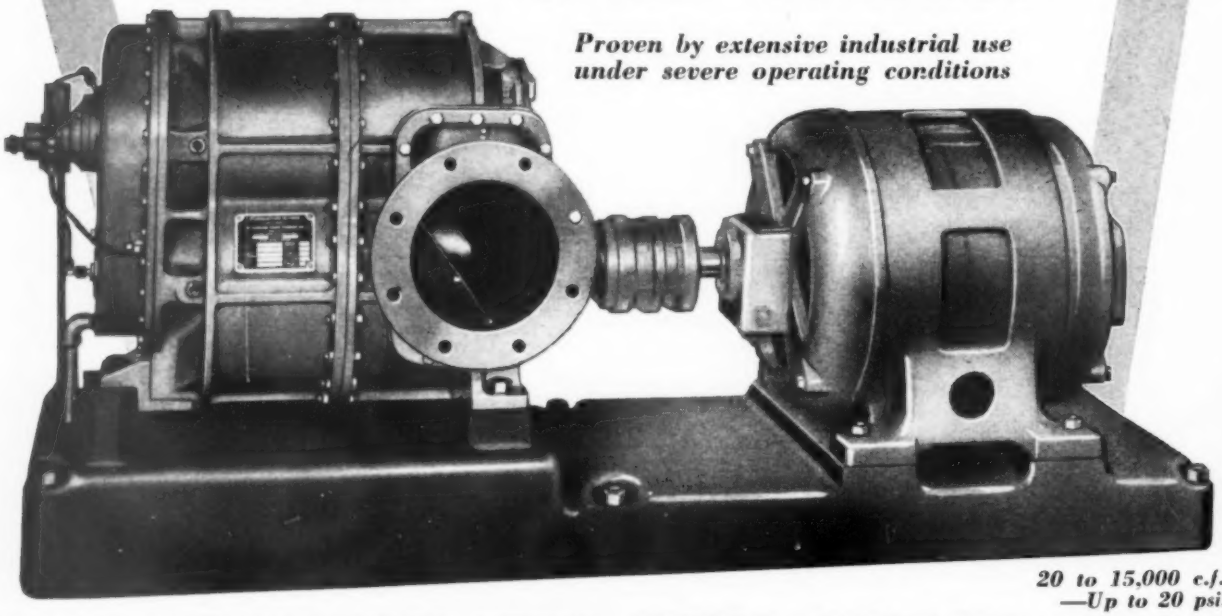
Proven by extensive industrial use under severe operating conditions



20 to 15,000 c.f.m. —Up to 20 psi.

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   No clatter or pounding. Sound level comparable to centrifugal blower.
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   Greater adiabatic efficiency allows lower applied horse power for most ratings. Maintains original efficiency as verified by continuous quiet operation.
3. **CUTS COST OF INSTALLATION**
   Quiet operation permits elimination of blower room in many instances.
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   Requires less layout area than conventional blowers of equal capacity.
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   Precision materials and select materials insure long life under continuous operation.

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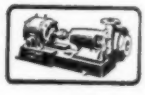

Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs Water Seal Pumping Units. Samplers, Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

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See the New "THRU-CLEAN" BAR SCREEN

at the Link-Belt Booths 6 and 7

F. S. W. A.
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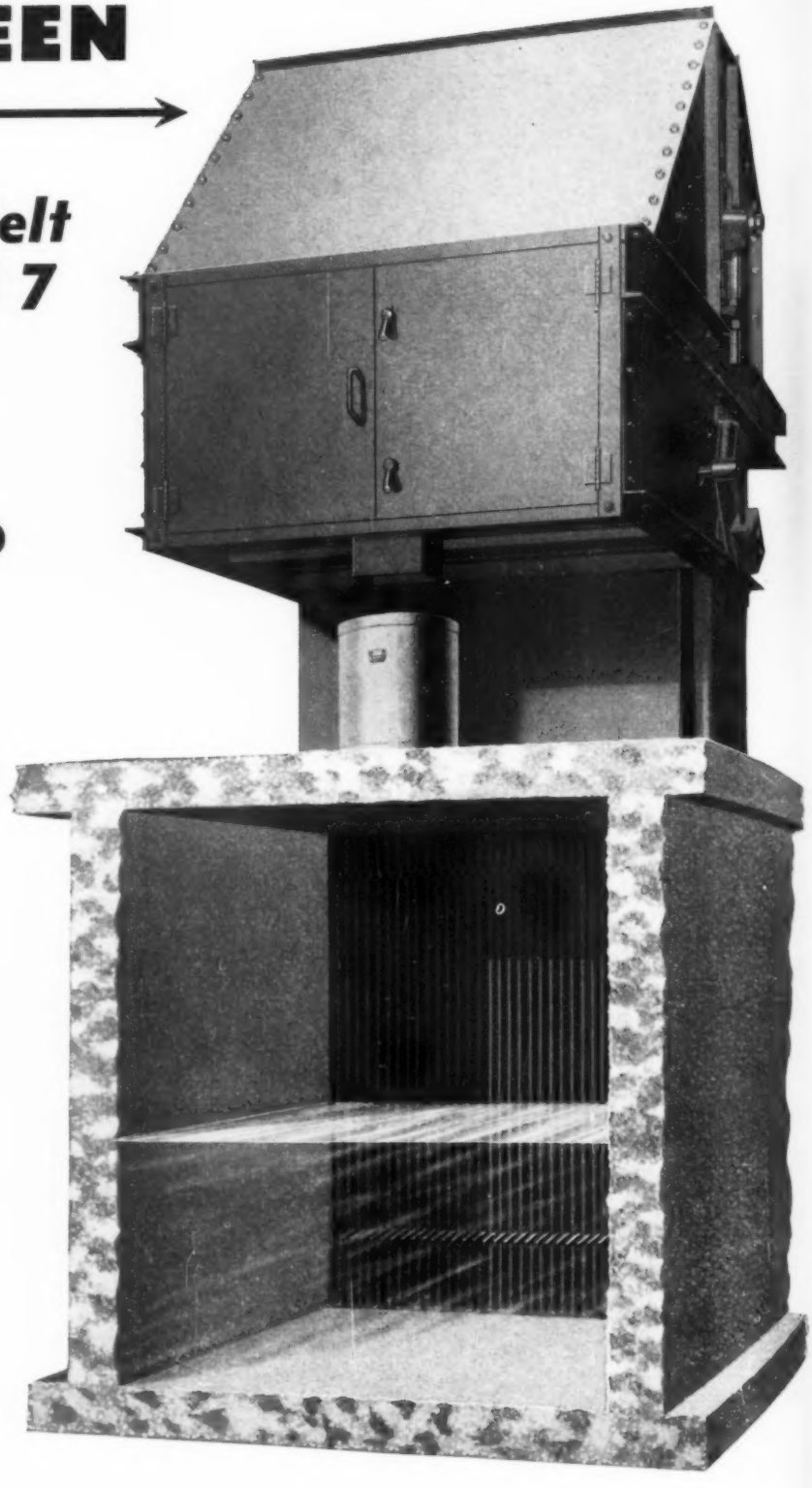

Be sure to investigate the new Link-Belt Mechanically Cleaned Bar Screen, and observe how the rakes clean thru the bars from the back.

This screen has many distinctive features. Bottom and top support of screen bars assures alignment. Vertical path cuts down the power required to operate and results in minimum chain wear. Chain take-up is on the head shaft where it is readily accessible for maintaining proper chain tension. The screen cannot be jammed by large objects settling in front of the screen bars since the rake will enter under and lift them.

The screen is of the usual rugged Link-Belt design and is accurately constructed to give long life under the most severe operating conditions. For detailed information, get in touch with our nearest office, or inquire at the Link-Belt exhibit.

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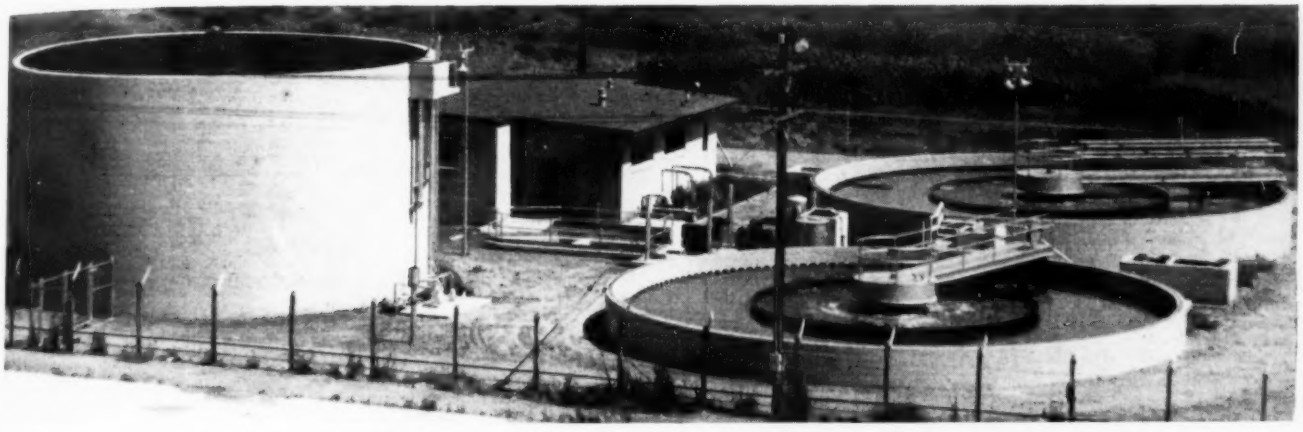
THE PROCESS OXIDATOR



Sewage treatment plant at Chula Vista, California (Kistner, Curtis and Wright—consulting engineers). A typical example of a compact operation utilizing a primary and secondary Oxidator in series.*

A REVOLUTIONARY NEW SEWAGE TREATMENT PROCESS THAT MEANS LOWER INITIAL EXPENDITURE, HIGHER EFFICIENCY IN OPERATION AND REDUCED MAINTENANCE COST. The Oxidator is a combination coagulation and sedimentation process in one tank. Air is used for mixing and recirculating previously settled sludge and floc with the influent. Your consulting engineer will immediately visualize the simplicity and advantages of operation . . . demonstrated and proven by successful installations during the past three years.

Process Oxidators are engineered to fit your needs whether large or small. Write to either address below and one of our specialized Engineers will be glad to assist with your particular problem.

THE PROCESS OXIDATOR
Installation will result in:

- Improved clarification
- Higher removal of suspended matter
- Increased grease removal
- Minimum scum handling
- Greater reduction in bio-chemical oxygen demand
- Elimination of odors by maintaining sewage in fresh condition
- Lower capital cost and upkeep

*Note: In the Chula Vista installation only the primary tank has a skimming device . . . not needed in the secondary. (Chemical coagulants may be added to the secondary tank to obtain removal of practically all suspended matter) Patents Pending

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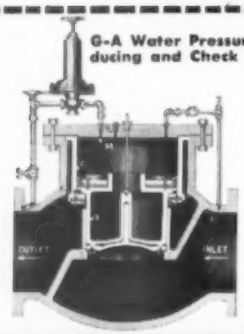
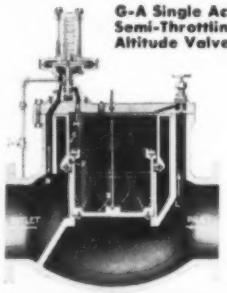
WATER PRESSURE Valves

G-A Water Pressure Reducing Valve

G-A Water Pressure Reducing and Relief Valve



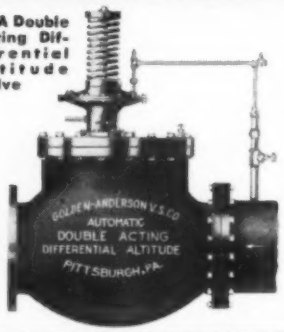
G-A Water Pressure Reducing and Check Valve



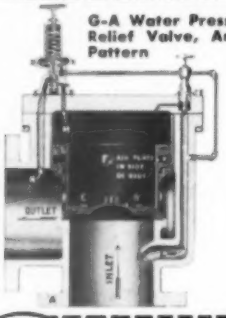
G-A Single Acting Semi-Throttling Altitude Valve

for every service installation

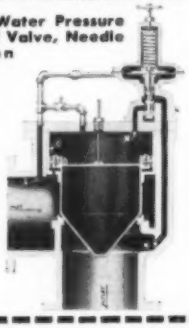
G-A Water Pressure Reducing and Double Acting Water Level Control Valve



G-A Double Acting Differential Altitude Valve



G-A Water Pressure Relief Valve, Angle Pattern



G-A Water Pressure Relief Valve, Needle Piston Type

OUR ENGINEERS can solve your flow control problems, either with one of the 1500 standard types and sizes of Golden-Anderson Valves, or with a special valve designed for your particular application.

GOLDEN ANDERSON Valve SPECIALTY CO.
KEENAN BUILDING
PITTSBURGH 22, PA.

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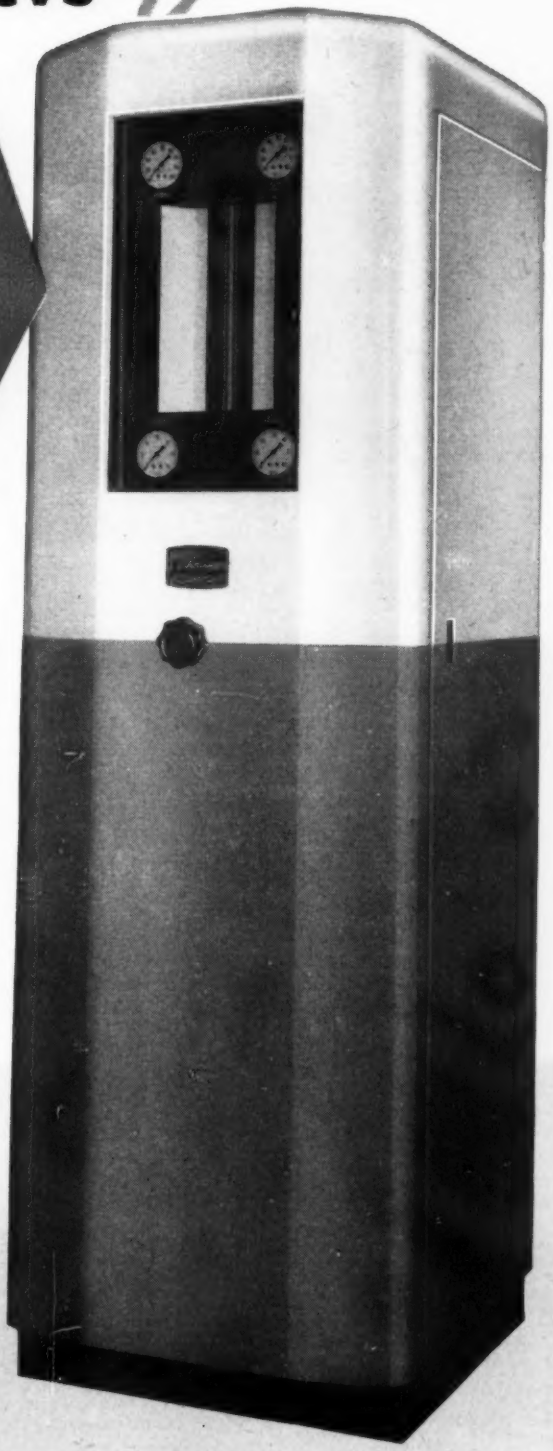
BUILDERS Chlorinizer

MODEL CVS

CHLORINE GAS FEEDER



Builders Vacuum Type Chlorinizer for metering chlorine gas and producing chlorine-water solutions is accurate, safe, and simple to operate. It is a thoroughly field tested product of Builders-Providence, Inc., a Company that has specialized in equipment for metering and controlling flow for more than 55 years, and with whom excellence in design and manufacture has been a tradition since 1820.

The Model CVS Volumetric Chlorinizer has a positive chlorine rate indicator which measures the actual gas flow and shows this rate of flow on a direct reading linear scale, providing equal ease and accuracy of reading at all rates. The flow of chlorine gas is automatically and positively shut off should any condition occur which would interfere with the safe operation of the Chlorinizer. It is readily adapted to semi-automatic, program, or automatic proportional operation. For Bulletin 840-F1 address Builders-Providence, Inc. (Division of Builders Iron Foundry), Providence 1, R. I.

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A COMPLETE LINE

The Chlorinizer is also available in another volumetric model, DVS, and in a gravimetric model, CGS. Bulletins on request.

BUILDERS PROVIDENCE

Instruments

WITH WATER RATES FIXED

you can't afford to let your meters

DIE AN UN-NATURAL DEATH

COSTS WAY UP **REVENUE DOWN**

TRIDENT WATER METERS

Tridents are simple, rugged and retain their high initial accuracy over many years of operation. Even after years on the line, new interchangeable parts fit old casings, make them "as good as new," at small expense. Thus Tridents are easily repaired to register at least 90% at ¼ gpm, the minimum acceptable performance for repaired domestic meters.

With present rates and operating costs, can you afford to lose as much as 30 to 40% of REVENUE that might be collected? Yet that is what you can lose, experience proves, when you neglect meters and fail to remove them for the tests and repairs that would quickly renew their youthful accuracy . . . for no meter need "die a lingering death" while you can get new parts that fit old models, as you can with Trident Meters.

The way long-neglected meters lose revenue is well illustrated by the experience of one water department. Out of a lot of 40 meters brought in from 9 residential streets for testing and repair, 36 would not even move on ¼ gpm. And when you consider that 25% of all water flows through domestic meters at 1 gpm or less, you can readily see the losses permitted by "half-dead" meters. Consult your Trident Representative for advice on a testing and repair program.

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NEPTUNE METERS, LTD., Long Branch, Ont., Canada

WATER & SEWAGE WORKS

Vol. 96, No. 10 OCTOBER, 1949

A Gillette Publication

DESIGN, OPERATION AND MAINTENANCE OF SMALL SEWAGE WORKS*

With Particular Reference to Housing Developments, Institutions and Camps

by

R. W. SIMPSON
Sanitary Engineer
GILBERT ASSOCIATES, INC.
READING, PENNA.

The Author

DURING the war years housing development was practically dormant, due to the shortage of material and labor. Since V-J Day the increase in construction of residential housing has skyrocketed but housing experts feel that the supply is still far behind the demand.

The trend in home purchasing today is away from the congested city areas towards the suburbs. Housing developers are purchasing large tracts of land in undeveloped areas, requiring installation of utilities.

Industrial development is increasing rapidly and with it housing developments especially in the south and southwest areas. With this rapid development industrially, increased pollution of our surface water supplies can be expected.

State laws in 44 states, the new Public Law 845, and the Ohio River

*This paper presented at the Second Annual Meeting of the Virginia Ind. Wastes & Sewage Works Assn., is published here by permission of the F.S.W.A.

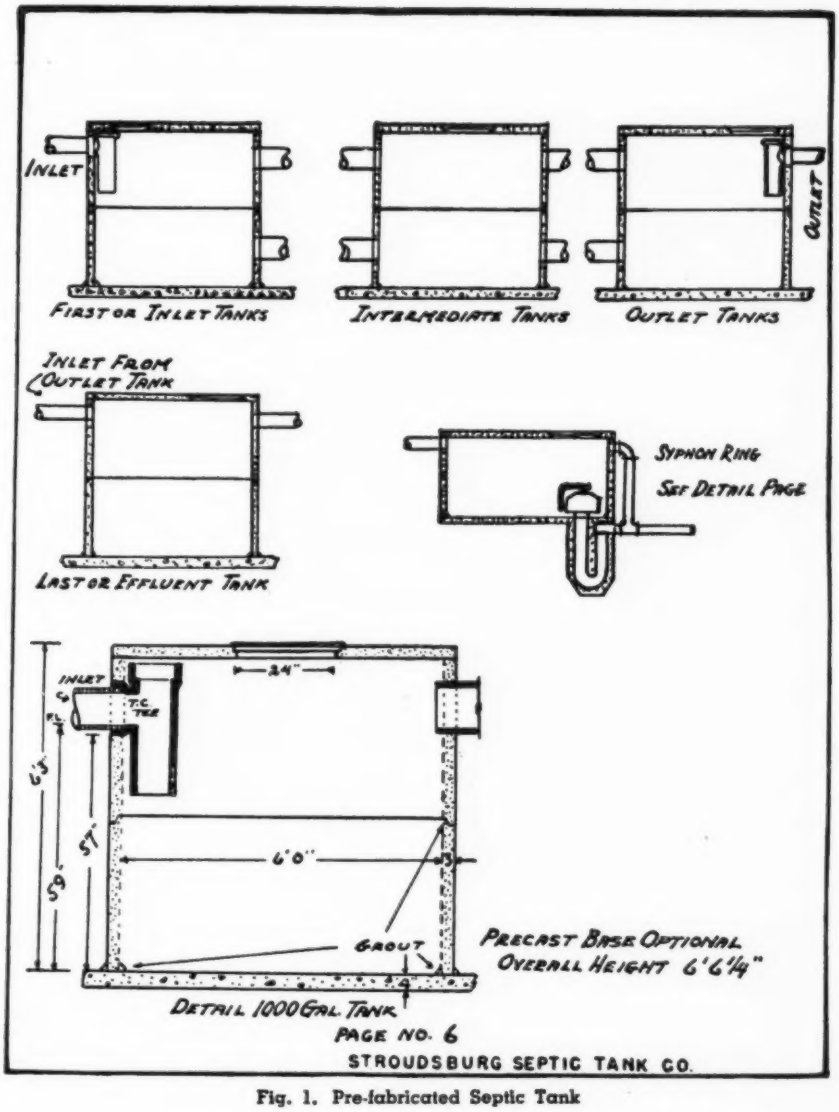

Fig. 1. Pre-fabricated Septic Tank

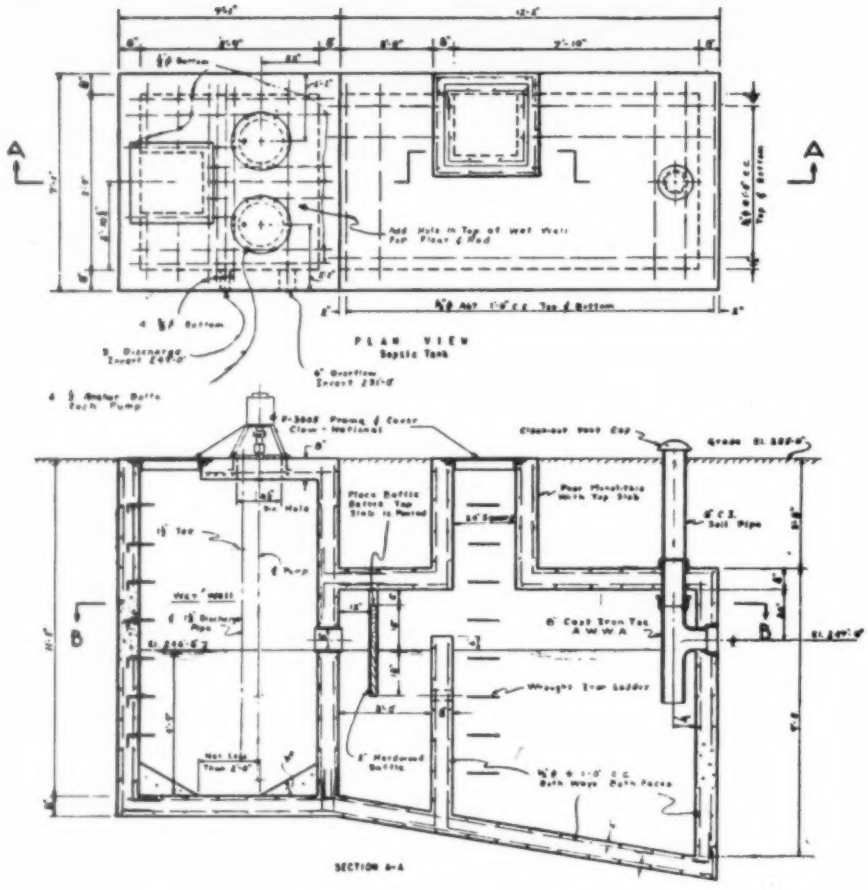

Fig. 2. Special Design of Septic Tank

and other interstate compacts all call for pollution abatement of both industrial and domestic wastes.

In order to meet the requirements of the various state pollution control bodies, housing developers have found it necessary to install or prepare plans for construction of sewage treatment plants. Institutions and camps are faced with problems similar to those of housing developments, in that small volumes are involved, and initial cost is an important item.

Methods of Treatment

In the design of sewage treatment plants for housing developments, institutions, and camps, the cost of constructing the required facilities is paramount. When sanitary sewers are already installed, the cost of a sewage treatment plant, in most cases, is not excessive. Where a complete sewer system is required, the cost may make the project prohibitive under existing construction costs. This discussion is devoted to the construction of the sewage treatment plant itself.

Complete treatment, resulting in 85 per cent reduction in B.O.D., is required in most cases today. It is the duty of the engineer to design a plant which will give the required degree of treatment at the lowest construction and operating cost. To do this requires considerable study.

A number of methods are commonly used for treatment of small volumes of sewage. The basic principles employed are similar, but the methods used vary considerably. Among the units most often used, we find the following:

1. Septic tanks
   (a) With drain fields or cesspools
   (b) With intermittent sand filters
2. Imhoff Tanks
   (a) With trickling or sand filters
3. Separate settling tanks and digesters
   (a) With trickling or sand filters
4. Dorr "Clarigesters"
5. Activated Sludge
   (a) Chicago Pump Package Unit
   (b) Yeomans Package Unit
6. Contact Aeration

Before discussing design details for the various methods of treatment available, it is necessary to consider general design data. Since most treatment plants for housing developments must be designed before the homes are built and no actual flow measurements can be made, an assumed flow of 100 gal. per capita per day is used. A B.O.D. of 200 ppm. and a suspended solids of 300 ppm. are usually used for raw sewage. In actual practice, where metered water is used, the flow is usually lower with a resulting increase in organic solids concentration.

The Septic Tank

The most common device used heretofore for treatment of small quantities of sanitary waste has been the septic tank. Septic tanks are used for treating sewage from individual homes and from small groups of homes. Industry has commonly used septic tanks for treatment of the sanitary waste from washrooms, etc.

Fig. 1 shows a typical pre-fabricated septic tank used for small volumes of sewage. By adding additional units, a battery of tanks can be obtained to treat as much as 17,000 gal. per day. Such pre-fabricated units are acceptable to some state health departments and not to others.

Fig. 2 shows a typical septic tank, designed specifically for a particular installation. This design with slight alterations is acceptable to most authorities.

In designing small septic tanks, a detention time of 12-16 hours is required, allowing 25 per cent additional for sludge storage. In large installations it is safe to reduce the detention time to 10-12 hours, again allowing for sludge storage. State requirements should be investigated to assure correct design criteria.

In general, rectangular tanks are preferable, with the length approximately four times the width. Tanks over 8 feet in length should be divided into two compartments, the inlet compartment having 65 to 75 per cent of the total capacity. In small tanks, treating 2000 gal. per day or less, tees may be installed at the inlet and outlet. Larger installations require the use of scum baffles in addition to the tees.

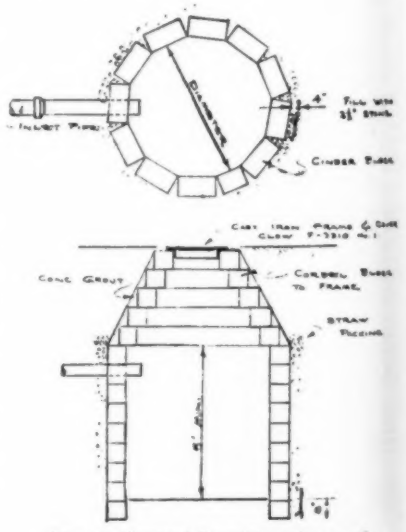

Fig. 3. Typical Leaching Cesspool

Access manholes are required over each compartment. The manholes should be brought up to grade to facilitate inspection and cleaning. Siphons, or pump wells, are required for discharging the effluent from the septic tank for further treatment, where the flow is 3000 gal. or more. For the design of the siphon, reference to standard hydraulic texts is required to obtain the necessary information.

The septic tank only takes care of solids removal and digestion; a percentage efficiency of 25-35 per cent can be expected. The liquid from which the solids have been removed must also be disposed of. Sub-surface drainage is the usual method; leaching cesspools or tile drain field may be used, in which case soil studies must be made to determine the percolation rate.

A method for conducting a soil test for sub-surface disposal follows: A test hole is dug approximately one foot square and 30 inches deep. The hole is filled with water to a depth of 6 inches, and the average time required in minutes for the level to drop 1 inch is observed. For a leaching cesspool, the hole should be dug to the proposed depth of the unit and the test made in the bottom.

Knowing the rate of percolation, the allowable rate of application can be obtained from Table I.

Table I

ALLOWABLE RATE OF SEWAGE APPLICATION PER SQUARE FOOT PER DAY*

Time	Trench Area	Cesspool Area
1 Minute	4.0 gal.	5.3 gal.
2 Minutes	3.2 gal.	4.3 gal.
5 Minutes	2.4 gal.	3.2 gal.
10 Minutes	1.7 gal.	2.3 gal.
30 Minutes	0.8 gal.	1.1 gal.
60 Minutes	0.6 gal.	0.8 gal.

*(New York State Department of Health requirements.)

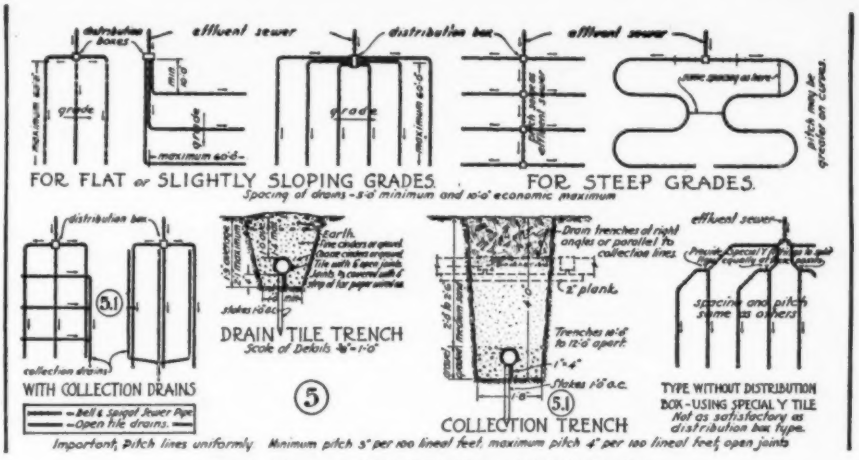
FOR FLAT or SLIGHTLY SLOPING GRADES
FOR STEEP GRADES
DRAIN TILE TRENCH
WITH COLLECTION DRAINS
COLLECTION TRENCH
TYPE WITHOUT DISTRIBUTION BOX - USING SPECIAL Y TILE

Fig. 4. Types of Sub-Soil Disposal Field Drains

With the rate known, the surface required for disposal can be determined. If drain tiles are laid in gravel, the side wall of the trench to the center line of the pipe can be considered as absorption area.

Fig. 3 shows a typical leaching cesspool and Fig. 4 a typical tile field. Note that in either case the utility of such a method is dependent on the soil conditions. Clay, gumbo, or a high water table makes subsurface disposal difficult and in many cases impossible.

The operation of septic tanks is quite simple and they require very little attention. Sludge levels and scum accumulation should be checked once each month. Digested sludge must be removed at intervals, depending upon the design and the use of the septic tank. This is usually done by employing a "honey-dipper" to pump the solids out. In some cases, sludge drawoff pipes are provided to eliminate pumping. It should be remembered that sufficient solids should remain in the tank to act as seed.

In some installations, especially where heavy loads from kitchens are encountered, scum collects in the septic tank to a point where considerable volume of the tank is no longer useful. Institutions and camps are more susceptible to scum problems than housing developments. If this scum is broken up mechanically, by stirring or by hosing-down, it will usually settle when the entrained gases have been removed. In many installations the septic tank is too deep in the ground to allow for such treatment and actual removal of the scum by pumping is required.

Where, in large installations, it is advisable to follow the septic tank by an alternating siphon in order to discharge the liquid to the tile drain field in slugs so that portions of the liquid will reach the far end of the drain field, occasionally the siphons should be inspected to make sure that they are not hung up. Hosing-down of the siphons reduces the odors which usually accompany the operation of such a unit and reduces the possibility of clogging.

In some installations where the porosity of the ground is not suitable for absorption of the volume of liquid applied, artificial subsurface sand filters have been used. In this case, approximately 30 inches of sand is used as a media for the biological organisms. The effluent from the septic tank is discharged at the top of the sand bed, trickles through to a collection system beneath the sand and is then discharged to the nearest receiving stream. A dosing rate of 50,000 gal. per acre per day is commonly used. This type of drain bed operates in the absence of oxygen and usually produces a very poor effluent. With this type of bed, the material must be discharged first to one-half of the bed for approximately 24 hours; then to the second half of the bed and vice versa. A diversion box is required to direct

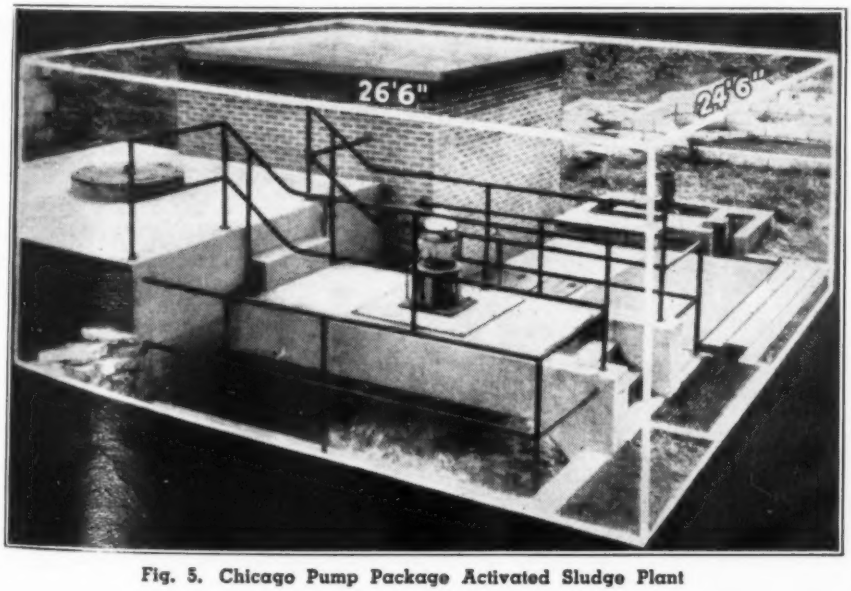

Fig. 5. Chicago Pump Package Activated Sludge Plant

the septic tank effluent to the proper bed. Daily change of the stop gates or valves is required at this diversion box.

Very little maintenance is required for septic tanks and tile drains. Occasionally a portion of the drainage field may become clogged-up, requiring either cleaning or replacement.

Where the soil conditions are not conducive to disposal of large volumes of liquid, an intermittent sand filter can be utilized following the septic tank. The installation of intermittent sand filters is rather costly and requires considerable space. In most installations of intermittent sand filters, nuisances are prevalent due to high odors and the presence of psychoda flies. In the design of intermittent sand filters, a rating of 75,000 to 100,000 gal. per acre per day can be used where primary treatment precedes the discharge. Where complete treatment precedes the intermittent sand filters, discharges as high as 400,000 gal. per acre per day may be used.

Intermittent sand filters should be divided into multiple beds to allow for alternate flooding. A good grade of sand, with an effective grain size of 0.25 to 0.5 millimeters, for a depth of 30 to 36 in. is required. Care should be given to installation of underdrains to maintain the proper slope. Installation of underdrains laid on grade stakes is recommended. Joints should be partially covered with roofing paper or wrapped with burlap.

It is usually conceded that the effluent from an intermittent sand filter is as good as can be obtained by existing methods of sewage treatment. The high degree of treatment is, however, offset by the high cost of construction.

In the operation of intermittent sand filters, it is necessary to alternate the beds so that no bed is flooded for more than a 12-hour period. When the beds have dried out and the top is covered with "Schmutzdecka", it is necessary to rake this material from the bed. In the actual operation of the intermittent sand filter, very little attention is required. In maintaining an intermittent sand filter, it is necessary to replace the sand occasionally, since the raking process removes a portion of the top layer. In a typical installation of an intermittent sand filter, it was desired to spend the minimum amount of operating time. Automatic valves were placed in the lines leading to the various sections of the bed. These valves are operated on a time switch so that each quarter of the bed is flooded for an 8-hour period. An alternator makes it possible to reset the valves after every cycle.

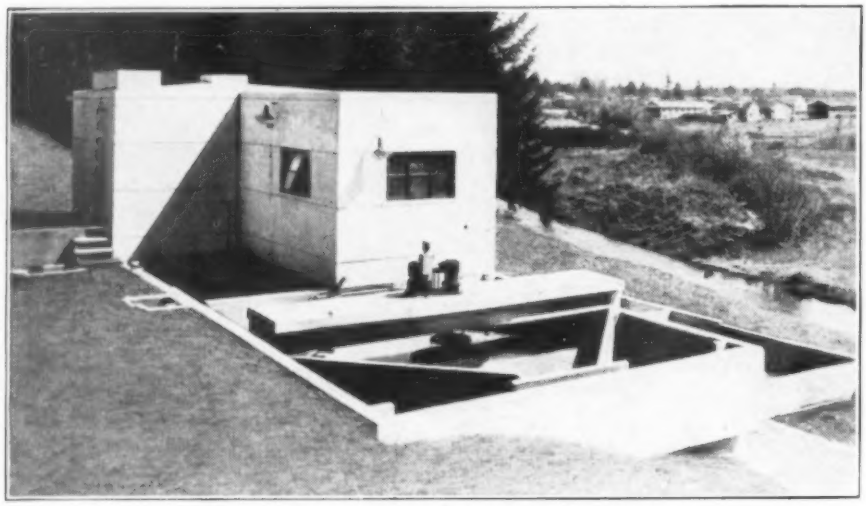

Fig. 6. Yeomans Bros. Activated Sludge Plant

Imhoff Tanks

Imhoff tanks are sometimes used as a method of removing and digesting solids. An Imhoff tank is in reality a two-story septic tank. In the design of Imhoff tanks, 2 to 3 hours' detention in the settling compartment is required. The tank should be so designed that the length is approximately five times the width. The sludge digestion compartment should have a minimum capacity of 3 cubic feet per capita served; gas vents should have a minimum width of 18 in.; sludge lines should be 8 in. in diameter for gravity discharge. Provision should be made to reverse the flow so that even sludge distribution in the digestion hopper will result. An efficiency of 35 to 40 per cent can be expected from a well designed and well operated Imhoff tank.

Operation of an Imhoff tank is quite simple. Cleanliness is very essential if odors are to be avoided. Operation consists of hosing down units daily, breaking up scum in scum compartments mechanically or by hosing down weekly, chaining the slot daily and withdrawing sludge approximately once per month.

Since no mechanical equipment is required, very little maintenance results. Sludge withdrawal lines may require rodding occasionally to keep them open.

Prefabricated welded steel Imhoff tanks have been used recently in the Wilmington, Del.,* area to treat the sewage from populations up to 250. Use of these units must be considered as a temporary measure, however. A patented type of settling tank and digestion compartment is the Dorr "Clarigester," a unit that has many advantages.

Separate Units

Only in a few installations, where small flows are encountered, have separate settling and digestion tanks been utilized. The cost of construction usually makes separate units prohibitive. Where such units are to be used, a minimum detention time of two hours is required in the primary clarifier. Sludge collection mechanisms should be installed, although hopper-bottomed tanks have been successfully employed. The digester should provide a minimum of four cubic feet of capacity per capita served, if unheated. The size of heated digesters can be reduced slightly. With separate settling and digestion, an efficiency of 40-45 per cent can be anticipated.

With either an Imhoff tank or separate settling and digestion units for complete treatment of the sewage, secondary processes are required.

Trickling Filters

In many small installations standard rate and high rate trickling filters have been used. In the design of standard rate trickling filters 250,000 to 300,000 gal. per acre foot per day are usually used. In the design of high rate trickling filters, discharges to the filter as high as ten times that for standard rate filters are allowable.

Standard rate filters with an effective depth of 6 to 8 feet are the most effective. The type of filter media depends upon the available stone in the locality where the plant is under construction. Slag, if available,

*Small Welded Imhoff Tanks, *Sew. Wks. Eng.* Sept. 1948.

with a uniform size of between 1½ to 2½ inches, gives the best results. By use of the larger stone better ventilation is accomplished and less ponding results.

Method of distribution on the filter may be either through fixed nozzles or rotary distributors. The latter give the most uniform distribution with fewer operating problems. Provision should be made for flushing or flooding the filters to reduce psychoda fly and control ponding. Operation of standard rate trickling filters is dependent upon intermittent dosing, requiring either dosing siphons or pump wells.

High rate filters, usually 3-4 ft. in depth, employ recirculation of the filter effluent to obtain the required degree of oxidation. With high rate filters, it is more essential that larger stone be used as media. Recirculation rates from as low as 1 to 1 to as high as 20 or 30 to one have been employed. The amount of recirculation depends upon the depth of filter, the type of distribution and the strength of the sewage being treated.

Although the cost for the construction of standard rate or high rate trickling filters is less than that of intermittent sand filters, it is still prohibitive in some installations. Large areas are required and final settling or humus tanks are required following the filters. With standard rate filters there are fly and odor nuisances; while with high rate filters these nuisance factors are considerably reduced. More attention is required in the operation of trickling filters. Where fixed nozzles are used for distribution of sewage over the filters, continual cleaning of the nozzles is required. Daily those nozzles which have become clogged must be cleaned. Where rotary distributors are used, less trouble is experienced with clogging, but it is found necessary to clean the orifice openings of the distributor arm in order to maintain equal distribution over the filter media. Trickling filters, although able to take fairly heavy shock loads, require more even loading over a 24-hour period than the intermittent sand filter. It should be remembered, also, that underloading in the case of trickling filters can do as much harm as overloading.

There are many advantages derived from trickling filters. A high quality effluent is usually obtained at a low operating cost. Although flies can become a nuisance in the trickling filter plant, with the use of DDT around the filter itself and in the influent to the filter, the psychoda fly can be controlled. Odors can be reduced by policing and cleaning of the units regularly. Where high rate trickling filters are used, attention must be given to the adjustment of the recirculation rate so that the filters are wetted at all times.

In the maintenance of trickling filters more time is required than with previous methods of treatment. Where fixed nozzles are used, it may be necessary to reseat or replace the nozzles after several years of operation. Where rotary distributors are used, the mercury or oil seals must be checked twice a year to maintain proper operation. It is also necessary to paint the rotary distributors to reduce corrosion.

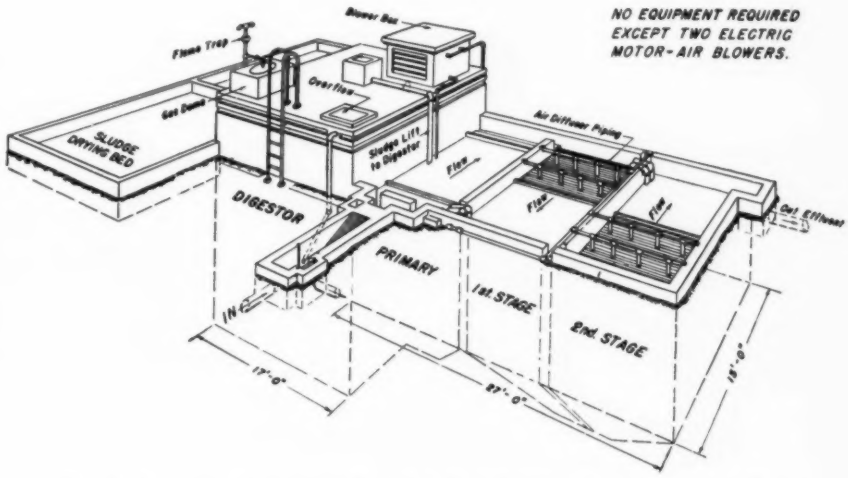

Fig. 7. Isometric Drawing of Hays-Schulhoff-Griffiths Contact Aeration Plant

Activated Sludge

Another method for the treatment of sewage for small communities is the activated sludge process. Many people do not realize that the activated sludge process can be utilized at very small installations. Several manufacturers have developed package-type plants which require very little space and make a compact unit. The cost of construction of an activated sludge plant is usually less than construction of any type of filter plant. The lower construction cost, however, is offset by a higher operating cost, since more power is required for the operation of either the mechanical agitators or blowers for production of compressed air. The activated sludge process, however, is limited in these small installations to uses where industrial wastes will not enter the system, since the process is very easily upset by heavy slugs of strong waste.

Air requirements are important in the design of activated sludge plants. Where mechanical aerators are used, no actual measurement on air input can be made. Where diffused air is used, provision for one cubic foot of air per gallon of domestic sewage treated should be made, although in most cases, 0.7 cubic foot is sufficient. Continuous return of activated sludge to the aeration unit should be provided, as well as a method for wasting activated sludge to the primary clarifier.

In the design of activated sludge plants, a detention time of 1 to 1½ hours in the primary is required; an aeration period of 6-12 hours is necessary depending upon the strength of the sewage to be treated; final settling tank capacity should provide 2 to 2½ hours' detention; digester capacity should be 4 to 5 cu. ft. per capita served.

There are many advantages in the use of activated sludge plants in small installations. The small area required and lower construction cost is, of course, important; with a well designed and operated activated sludge plant, odors will be at a minimum, and few, if any, psychoda flies will breed in the environment. Results of the activated sludge plants are very good with a high degree of treatment produced. Fig. 5 shows a typical Chicago Pump Package Plant and Fig. 6 a Yeoman's Unit.

The package type activated sludge plants are as nearly automatic as possible, with very little attention to operation required. It is necessary, however, for an operator to check the operation of the blowers or mechanical aerators daily for possible mechanical failures and to provide proper lubrication. It is advantageous in the operation of activated sludge plants to have laboratory tests run occasionally. Such tests as pH, suspended solids, dissolved oxygen, B.O.D., nitrites and nitrates are re-

quired. It is essential to determine the solids in the aeration units regularly in order to maintain the proper concentration. In some installations it has been found necessary to pretreat the supernatant liquor returned from the digester. In these cases, usually raising the pH with lime and pre-aeration is sufficient to provide a supernatant liquor which will not upset the plant.

Sludge must be withdrawn from the primary clarifier to the digester at least twice each day; if sludge is allowed to remain in the primary clarifier too long, septic action and B.O.D. increase will result. In the activated sludge process it is essential that sewage remain as fresh as possible to avoid septic action, resulting in high oxygen demands.

Occasionally, sludge bulking occurs due to excessive loads or over-oxidation. The operator must be familiar with the symptoms of sludge bulking and must be prepared to reduce the suspended solids in the aerator, chlorinate the return sludge, or reduce the air in-put, depending upon the cause of the bulking. Technical assistance may be required in these cases.

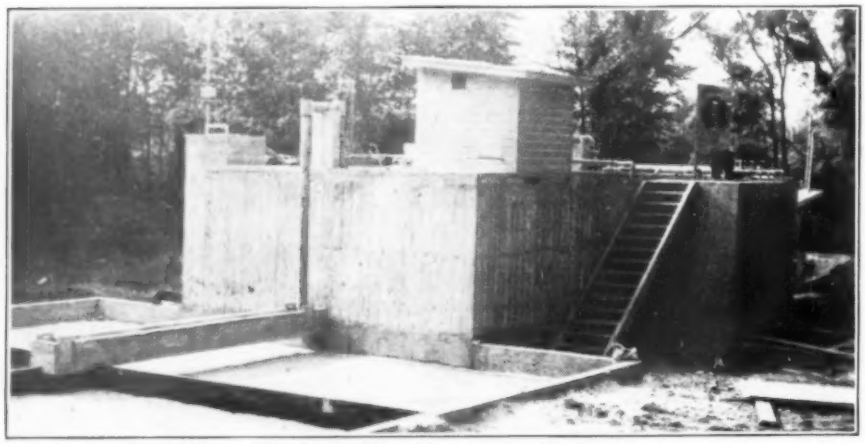

Fig. 8. Typical Contact Aeration Plant

Contact Aeration

In the southwestern section of the country, the Contact Aeration Process has been used successfully for the treatment of sewage from small developments. (Figs. 7 & 8) Recently several plants based on this process have been built in Virginia and Maryland. The process is similar to activated sludge in that air is employed, but the organisms performing the work are similar to those in a trickling filter.

A detention time of 1½ to 2 hours is required in the primary clarifier; hopper bottoms with air lift pumps are utilized for sludge removal. Aeration takes place in two units, a primary aerator and secondary aerator, separated by an intermediate settling tank. The combined aeration units should provide 3-4 hours' detention, depending upon the strength of the sewage to be treated. The intermediate settling tanks and final settling tank should have a combined detention time of 3-4 hours. For simplicity of construction the settling tanks are usually built the same size as the aeration units. Digester capacity equal to 5 cu. ft. per capita served is recommended.

Just as with activated sludge, air requirements for contact aeration plants is very important. To provide sufficient air for oxidation of normal domestic sewage, a minimum of two cubic feet of air per gallon of sewage is required. Stand-by aeration equipment is advisable, since the entire plant can be upset in a short time due to a blower failure.

The method of introducing the air into the sewage should be considered. In the past, when perforated pipe was used, low efficiencies resulted. The use of porous carborundum diffusers has increased efficiency considerably. The most important factor in obtaining high efficiency is the introduction of large numbers of small air bubbles, rather than high air production at high pressures.

Just as with activated sludge, the operation of contact aeration plants can be made nearly automatic. Using time clocks and automatic valves, sludge can be pumped at odd hours when the operator is not present. Daily inspection of all mechanical equipment is required. Cleanliness of the plant is essential to eliminate odors. Occasionally, the air to the diffusers requires adjustment. Sludge must be withdrawn from all units manually at least twice each day, if automatic valves are not installed. It is occasionally necessary to remove heavy plate growth with water pressure or compressed air.

The efficient operation of a contact aeration plant is dependent upon the maintenance of dissolved oxygen in all units. A D.O. test should be run daily on each unit; should D.O. be lacking, more frequent withdrawal of sludge may be required, recirculation of final effluent or increased air indicated.

Maintenance of contact aeration plants requires replacement of oil in the blowers, lubrication of moving parts and cleaning of air filters and diffuser tubes when required. Regular checks of the air pressure from the blowers must be made to determine the cleanliness of the diffuser tubes.

Construction Costs

Some mention should be made concerning initial cost of constructing sewage treatment plants. With the unstable cost of construction today, it is difficult to make any hard and fast rule. Experience indicates that methods of treatment using filters is the most costly per capita served. Construction costs for high rate filters will be approximately two-thirds the cost of standard rate units. Intermittent sand filters are the most expensive, due to the large area required. Construction costs for activated sludge plants will be about equal to those for high rate trickling filters. Cost of contact aeration plants will be slightly less than activated sludge plants.

Operation costs seem to be inversely proportional to construction costs, with the most economical operation for standard rate filters and the highest cost for contact aeration plans. High operating costs for mechanical plants are due to the high power consumption.

Sewage treatment for small housing developments, institutions and camps is a must where no existing sewer is available. Several methods are available for treatment, and the selection of the type of treatment to be utilized depends upon the size and type of the receiving stream, the area to be served, the capital investment for construction and the operation cost. In general, mechanical aeration methods are less expensive to build than filters and give a higher degree of treatment, but require more technical operation.

FEDERATION PROGRAM ISSUED

Boston Meeting Bids Fair to be Best Yet

THE 22nd Annual Meeting of the Federation of Sewage Works Associations to be held in Boston (Hotel Statler) October 17-20, bids fair to be the best meeting ever held by the Federation. It is to be highlighted by a technical program of noteworthy diversification and timeliness.

THE PROGRAM

MONDAY, OCT. 17

Morning

Registration and Inspection of Exhibits.
Opening of Meeting—Pres. V. M. Ehlers.

Welcome to Boston
Walter H. Brown, Jr., Pres., New Eng. Sewage Works Assn.

Progress in Solving the Sewage Pollution Problems of the Massachusetts Metropolitan District
Karl R. Kennison, Chief Engr., Metropolitan Dist. Water Supply Comm., Boston.

Sewage Treatment and Disposal for Boston
Robert P. Shea, Sewer Division Engr., Boston Public Works Dept.

Afternoon

Bacterial Standards for Natural Waters
Dr. Abel Wolman, Prof. of San. Engineering, Johns Hopkins Univ.
Discussion: A. H. Stevenson, San. Engr., U.S.P.H.S.

Application of Sodium Nitrate to the Androscoggin River
Walter A. Lawrence, Prof. of Civil Eng., Bates College.

Statistical Approach to Stream Pollution
C. J. Velz, Prof. of San. Eng., Manhattan College.
Discussion: R. N. Clark, Chief Public Health Engr., T.V.A.

Problems Relating to the Disposal of Sewage into Tidal Waters
R. G. Tyler, Prof. of Civil Eng., Univ. of Washington.
Discussion: R. H. Gould, Director of Eng., Dept. of Public Wks., N. Y. City.

Evening

Reception and Entertainment—Imperial Ballroom

TUESDAY, OCT. 18

Morning

Moving Picture—"A Tale of the Twin Cities"
(Courtesy, Minneapolis-St. Paul San. Distr.)

High Rate Trickling Filter Operation on Formaldehyde Wastes
B. W. Dickerson, Sanitary Engr., Hercules Powder Co.
Discussion: H. Heukelekian, Research Engr., Agri. Expt. Sta., Rutgers Univ.

Treatment of Distillery Wastes
A. B. Davidson, San. Engr., Schenley Distilleries.
Discussion: M. W. Tatlock, Consulting Engineer.

Treatment of Wastes from the Meat Packing Industry
Leland Bradney, Walter Nelson, and R. E. Bragstad, respectively, Chemist, Sewage Treatment Plant; Mechanical Supt., John Morrell & Co.; and City Engineer, Sioux Falls, S. D.
Discussion: C. N. Sawyer, Prof. of San. Eng., M.I.T.

Industrial Wastes Disposal at Pittsburgh
J. F. Laboon, Chief Engineer, Allegheny County Sanitary Authority.
Discussion: H. H. Black, Chief, Industrial Wastes Sect., U.S.P.H.S.

Noon

Annual Federation Luncheon

Address: "Sanitary Engineering in a Changing World"
Gordon M. Fair, Dean, Graduate School of Engr., Harvard Univ.

Afternoon

Sewerage and Sewage Treatment in the Colne Valley, England
W. F. Brown, Chief Engr., Colne Valley Sewerage Board, Eng.
Discussion: R. S. Rankin, Engineer, The Dorr Co.

Air Diffusers for Activated Sludge—Comparative Tests and Studies
Norval E. Anderson, Engr. of Treatment Plant Design, Sanitary Distr. of Chicago.
Discussion: John J. Wirts, Supt. of Sewage Disposal, Cleveland, Ohio.

Mechanical Equipment in Sewage Treatment
Frank L. Flood, Consulting Engr., Boston.
Discussion: Charles R. Velzy, Consulting Engr., New York.

Evening

Twentieth Anniversary Dinner, New England Sewage Works Assn. at Northeastern Univ.

WEDNESDAY, OCT. 19

Morning

Moving Picture—"Training in Los Angeles."

The Training of Sewage Works Operators in the U. S.
William T. Ingram, Assoc. Prof. of Public Health Eng., New York Univ.
Discussion: Bernard S. Bush, Distr. Engr., Penna. Dept. of Health.

Maintenance and Operation of Large Sewer Systems
T. A. Berrigan, Chief Engr. Sewer Div., Metro. Distr. Comm., Boston.
Discussion: W. P. Gyatt, Supt. of Sewage Treatment, Syracuse, N. Y.

Basic Research on Standard Methods
W. D. Hatfield, Supt., Sewage Treatment, Decatur, Ill.
Discussion: M. Starr Nichols, Chief Chemist, Wisc. State Lab. of Hygiene.

Afternoon

Inspection Trip
Nut Island Treatment Plant.
Sedgwick Laboratories of Sanitary Science, M.I.T.

Evening

Annual Federation Dinner and Dance—Imperial Ballroom

THURSDAY, OCT. 20

Morning—Concurrent Sessions

Operators' Forum
LeRoy W. Van Kleeck, Leader

To Lime or Not to Lime.
Sewage Disposal vs. Sewage Utilization.
Laboratory Tests for the Small Plant Operator.
Eliminating Cross-Connections at Sewage Works.
What Operators Want Most in Sewage Plants.
Design and Operation of Booster Sewage Pumping Stations.
Design and Maintenance of Sewers.

Industrial Wastes Forum
Stuart E. Coburn, Leader

Cannery, Milk, and Other Food Products
Norris H. Sanborn and Charles C. Agar.
Chemical Wastes
Lyman Cox and R. W. Hess.
Oil Refinery Wastes
R. F. Weston.
Paper Mill Wastes
W. A. Lawrence and Don E. Bloodgood.
Plating and Metallurgical Wastes
J. E. Cooper and W. S. Wise.
Textile Wastes
J. A. McCarthy and H. G. Baity.

Noon—Adjournment

FIRST MAGNETIC-DRIVES FOR SEWAGE PUMPS

Will be Installed at the Nut Island Treatment Plant, Boston, Mass.

by

HERBERT J. MEEKER
Ass't. to the Vice President
WORTHINGTON PUMP & MACH. CORP.
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IT is desirable in many pumping stations that the capacity and arrangement of the pumping equipment be such that the rate of pumping will conform as closely as practical to the rate of inflow to the wet well from which the pumps take their suction. This is especially desirable in a pumping station that will operate over a wide range of flow and pumping head and where the volume of flow is such that the surges developed, due to sudden changes in the rate of flow, must be avoided as far as possible.

Such conditions are frequently encountered in pumping stations handling raw sewage, including storm flow, where the range of flow to the station from minimum dry weather to maximum storm flows are extreme and storage volume is limited. If the pumping units discharge through a single conduit of considerable length, the problem is further complicated by a wide variation in pumping head, resulting largely from the higher friction head at maximum flows.

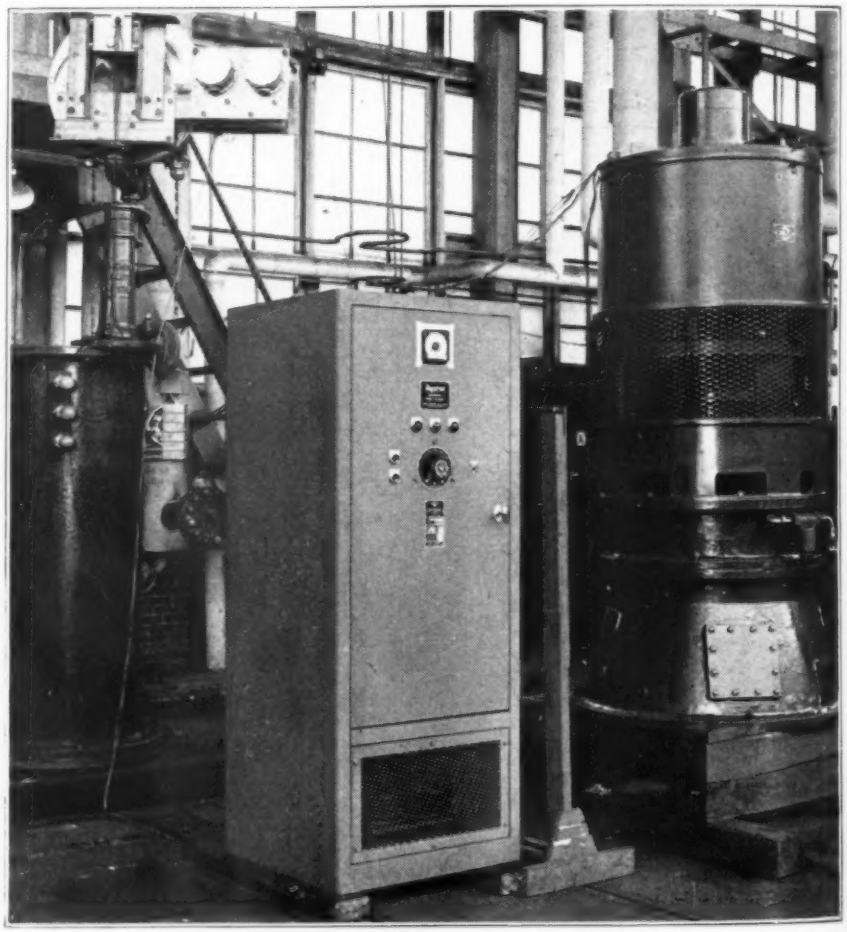
For many years pumping stations for sanitary, as well as water works and drainage service, were self-contained plants with steam boilers and engines or turbines driving the pumping units. The Diesel engine or gas engine has been used in other plants, and continues to be a favored prime mover where conditions warrant its selection.

It is evident that pumps driven by such means can be readily operated at various speeds, and a wide range of capacity and head obtained at good average efficiency. The rate of pumping can be maintained to approximately correspond to the service demand, or the rate of inflow to the plant.

As electric power became more dependable, and better rates for purchased electric power were obtainable, engineers turned more to motor driven pumps. Especially for the larger size units the higher efficiency and better power factor of synchronous motors made them a desirable selection for sewage and water works pumping stations and for similar service.

The Author

When a pumping plant discharges into a system with a balancing reservoir, or when the head is mostly vertical lift with rather short discharge lines, the characteristic of constant speed pumps fits the plant system head throughout the range of plant capacity, and parallel operation of several pumps of the same design is practical. Apply the same pump characteristic to a system head that rises sharply at increased capacities and the result is not very satisfactory. Pumps designed to discharge against



Motor, Magnetic-Drive and Control Units

Units assembled for test-demonstration in Worthington's shop. Motor, magnetic-drive and planetary gear assembly on right. Regutron (magnetic-drive excitation control unit) in center. On left (above) is the flow control unit, actuated by a single pump well float to control all pump units automatically, on basis of needed service to maintain pump well level and keep pace with varying sewage flow.

the maximum system head will be inefficient for normal conditions and, conversely, a characteristic to give good efficiency for normal operation will deliver a very limited flow, or possibly none at all, at the maximum system head.

Solutions to Variable Head—Variable Flow Problem

Various means are used to solve this problem:

(a) A multiple unit plant with a series of pumps designed for increasing capacities and heads.

(b) Pumps driven by wound rotor motors designed for variable speed with resistance control or liquid rheostats.

(c) Pumps driven by two speed motors of either the synchronous or induction type.

(d) Designing pumps for a compromise head between minimum and and maximum system head.

The multiple unit plant (a) with constant speed pumps is usually planned to cut in and cut out various units with a sequence control as the rate of flow and the pumping head increases. Obviously, a relatively large number of units may be necessary to adequately cover the range of capacity and head, and a large and expensive pumping plant is usually required. With frequent starts and stops of the motors, the starting inrush may well increase the power demand and pumping costs.

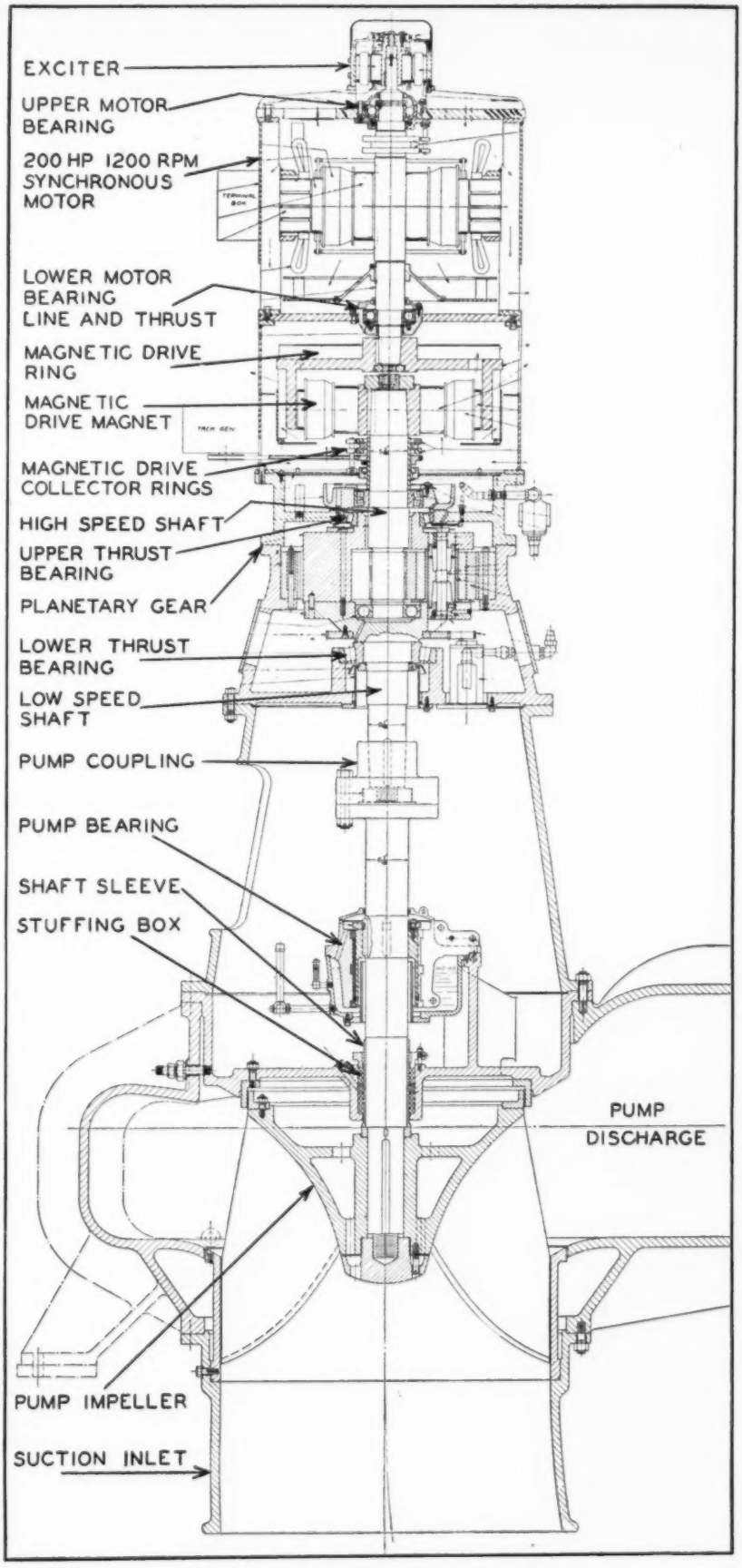
Variable speed wound rotor motors (b) solves the problem of obtaining good flexibility for variation in pumping rates and head, but the efficiency and power factor are lower and the price higher than for synchronous motors. The control range is usually ample.

The two speed motors (c) are a compromise, but in some cases do provide sufficient flexibility for satisfactory plant operation. Where close regulation is required, however, the changes in the rate of pumping from high to low speed are too great.

The "Magnetic Drive" for Flexibility

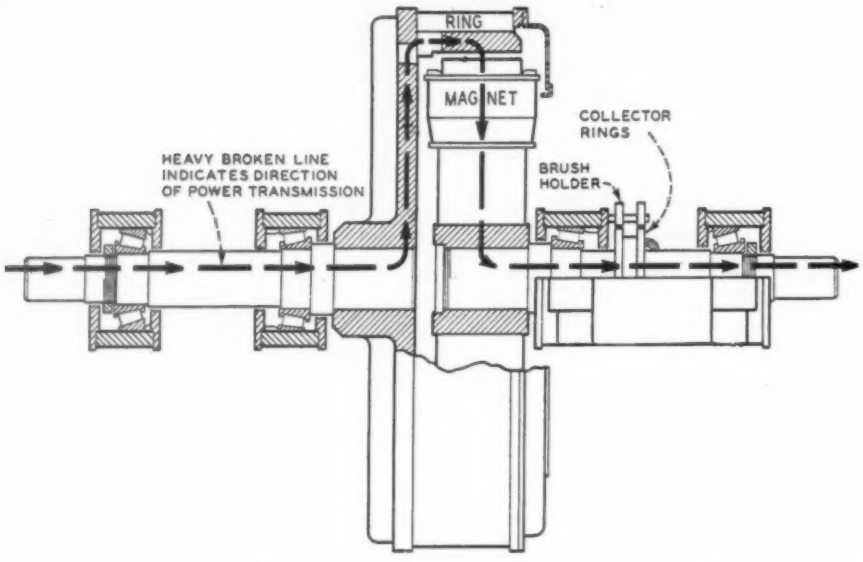
There has been for sometime a need for a driver of simple and reliable design for pumping plants that combines the advantages of a synchronous motor drive with the flexibility of the variable speed wound rotor motor. To realize such advantages "Magnetic Drives" have been used for many years in power plants for driving centrifugal blowers and similar uses. All such drives have heretofore been of the horizontal shaft type.

In its most simple form the magnetic drive (see cut) consists of a



Section Through One of the Nut Island Magnetic-Drive Pump Units

Note that there is no physical connection between the single speed motor and pump shaft, the speed of pump being determined by degree of excitation of the magnets which form the "spokes" of the magnetic-drive unit. Also see "Diagrammatic Section" illustrating principle of magnetic-drive.



Diagrammatic Section Showing Principle of Magnetic Drive.

Although depicting a horizontal drive, this sketch reproduced from an article by C. W. Camp in "Water & Sewage Works" for June, 1946, illustrates the principle of the drive. Note the absence of any physical connection between the motor-shaft ring and the magnet-wheel on the pump-shaft. Note path of power transmission from motor-shaft across the gap and through drive unit to pump-shaft. The degree of magnet excitation determines ratio of motor speed to pump speed, thus producing a smooth, stepless gradation of pump delivery with a constant speed economical synchronous motor.

driving element called a ring that is driven from the motor shaft, and a driven element called a magnet that is attached to the driven shaft. The magnetic drive control is called a regutron, which applies, electronically, the excitation necessary to transmit torque to the driven shaft, and determines the speed at which the driven shaft will operate. For manual operation the amount of excitation is simply controlled by means of a potentiometer mounted on the door of the regutron cabinet.

When the magnetic drive is fully excited the speed of the driven shaft will be about 3% less than the speed of the driving shaft. By reducing the excitation with the potentiometer the speed will be gradually reduced to any desired lesser speed down to ten per cent of normal. For centrifugal pumps a speed reduction of more than 25% is rarely needed.

Several mechanical arrangements for the magnetic drive can be obtained. For horizontal settings the ring and magnet of the drive are usually mounted in bearings of the anti-friction type, thus making a self-contained unit. For vertical shaft applications where close coupled pumps are used, the ring of the drive can be mounted directly on the motor shaft and the magnet of the drive attached to the pump shaft, thus forming a very simple electric coupling. When the pump motor is mounted on a separate floor above the pump a self-contained arrangement of the magnetic drive with independent guide and thrust bearings is desirable.

First Application in Sewage Pumping

The first application of this drive for a pumping plant is for the pumping units of the Nut Island Sewage Treatment Plant, designed by the Metropolitan District Commission, Boston, Mass. The engineers considered various other means to obtain stepless speed control that they considered desirable for the close regulation of pump output needed for this pumping station. It was also necessary to have a drive that could be attached to a vertical shaft pump. The magnetic drive appeared to meet all the requirements.

The pumps for the Nut Island plant are of the mixflo type with vertical shaft bottom suction and 48 in. discharge. Suction elbows of special design are used to cause minimum disturbance at the pump intake. The pumps are close coupled design with the motors and magnetic drive mounted on a planetary gear housing (see cut) which is supported on the pump casing.

The plant will have a very wide capacity range of 35 mgd. to approximately 250 mgd. The pumping head will be 10-ft. at maximum capacity and approximately 8 ft. with a single pump in operation at minimum flow. Each pump is rated at 85 mgd. at normal speed. Three units will be in operation at maximum station capacity, and one unit will be a spare. Due to the large unit capacity and low operating head, the pump speed is only 190 rpm. To obtain higher efficiency and lower cost for the motors and magnetic drive a planetary gear with 6 to 1 ratio, with motors and magnetic drive designed for 1,200 rpm., were selected. The range of speed for the variation in head and output of each pump is 140 to 190 rpm. The rated horsepower of the pump motors is 200.

The problem at Boston's Nut Island plant which dictated the selection of variable speed pump units results from the fact that satisfactory operation of the comminutors, located between the grit chambers and the pump wet well, requires a very close regulation of the level in the pump well. The specifications for the pump control installation state that the level shall not vary more than 3 in. above and below a normal operating level that will be determined after the plant has been placed in operation. This requirement holds for the range of 35 mgd. to 250 mgd. plant capacity.

Control Equipment

To control the four pumping units it was decided to use a single float well. From experience with similar plants, a 14 in. float weighing about 75 lb. was selected to provide ample torque for the operation of the four potentiometers that control the amount of excitation to the magnetic drive. The speed of the pumps is thereby adjusted from 140 minimum to 190 maximum rpm. This can be done manually from a duplicate potentiometer mounted on the door of the regutron cabinet, or automatically by means of the float control unit.

It was decided to use manual operation for cutting in and out of additional pumps as the sewage flow to the pump well increases or decreases. With one pump in operation at minimum speed, as the capacity and speed increases up to the maximum of 85 mgd. at 190 rpm., it was decided to hold this unit in service by overtravel of the float. By means of a mercury switch provided in the flow control, an alarm will be sounded to notify the operator that a second unit should be started.

With two units then in operation the speed of both units is adjusted to equally divide the output between two pumps. With further increase in the station flow, requiring a third unit, the alarm is again sounded and the operation is repeated. After manual start the float control automatically controls the speed of all units in service.

With decreasing flow, the reverse of the above operation is applied. If the minimum speed of one unit in service tends to overpump the wet well, another mercury switch shuts off the excitation to the magnetic drive. This causes the pump to come to rest, but the motor remains in operation to pick up the load as soon as the rate of flow to the station increases. If desired, all the above operations, including starting and stopping of units, can be made fully automatic.

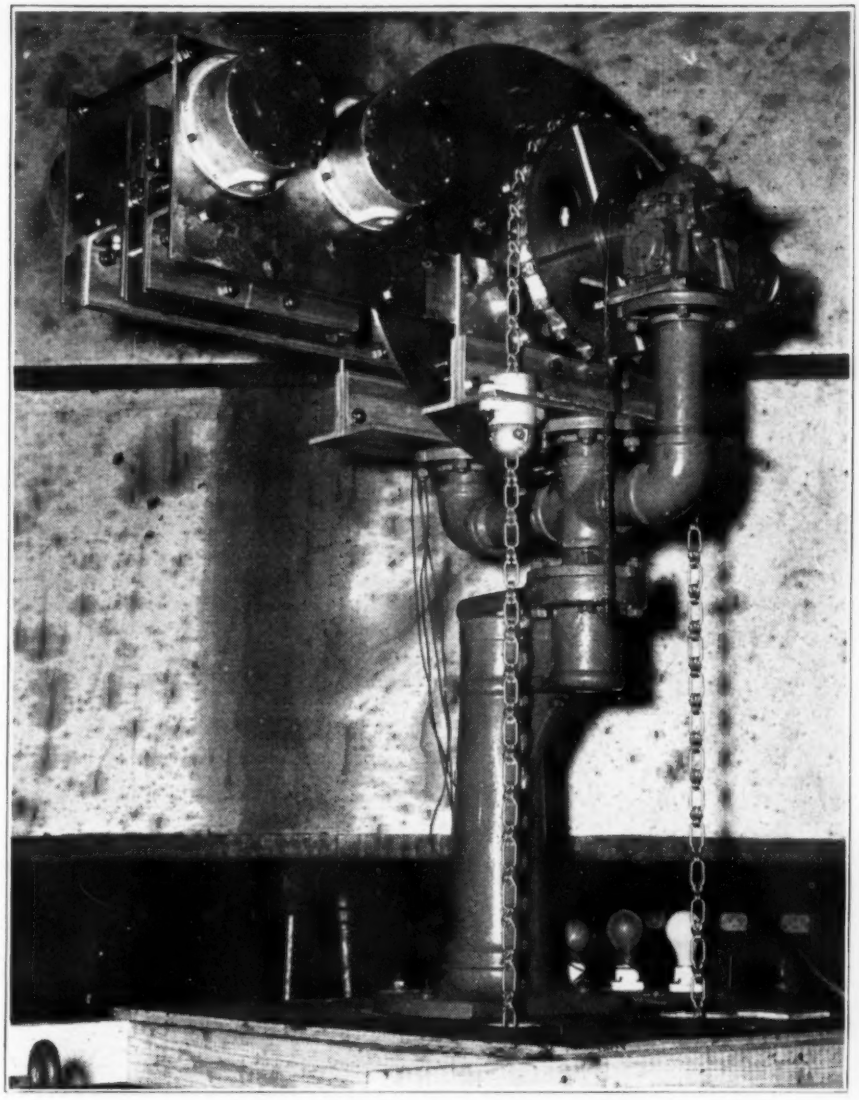
The Flow Control Unit

The flow control unit for the operation of the station is a rugged machine of simple design. All parts are made of corrosion-resistant material and all moving parts operate in antifriction bearings, to assure maximum torque for the operation of the potentiometers.

The mechanical features of the design to obtain the automatic operation of all units in service at the same speed are a cam track with overtravel that is mounted on a disc driven direct from the float sprocket wheel (see cut). This cam track operates the potentiometers through a rack and pinions. The movement of the rack is limited to the rotation of the disc through the range of the cam track. Overtravel beyond the cam track on to a circular track thus holds the pump speed to either maximum or minimum until the mercury switches function to either start or shut down pumps, as the station flow demands.

The flow control can be either floor mounted, or wall mounted. Provision is made to prevent overtravel of the float beyond a desired limit. Adjustment is provided to position the float after water level limits have been established for the wet well.

As the building to house the pumping units has not been completed, it has not been possible to install the equipment and make a field test. A shop test of the full size pump was not practical on account of the large capacity and the low operating head. The hydraulic performance of the pumps was, however, demonstrated by a homologous model. The full size unit was later set up complete with the reduction gear, motor and magnetic drive. The flow control for operating the magnetic drive was also set up so that the 6 in. maximum variation in suction well level varied the pump speed throughout the required range to pump from the maximum down to the minimum unit capacity.



The Flow Control Unit at Close Range

Operates the potentiometers of the regutron to effect automatic pump control from a single pump-well float. In combination with the regutron this device causes cutting in and out of pumps, and also adjusts pump speeds to equalize operating load between all operating units automatically.

This test was conducted before the engineers of the Metropolitan District Commission. Demonstration of the magnetic drive and the flow control were later made before groups of interested engineers.

Due to the need for maintaining close regulation of the suction well level at the Nut Island plant, *all* of the units are provided with magnetic drive. Where local conditions permit a greater variation in suction well level, it is practical to use a combination of constant speed and variable speed units. An example is the Central Schuylkill and South East Pumping Stations being built by the City of Philadelphia, Pa. Each of these pumping stations will have six 30-in. raw sewage pumps. Four (4) units will be constant speed and two (2) units in each station will be provided with magnetic drive for variable speed operation. The operating conditions at Philadelphia permit the pumps and motors to be direct connected. The motors and magnetic drive are mounted on cradles supported from the pump casings, similar to the design of the Nut Island pumps. This construction has the advantage of eliminating an expensive motor floor, and assures an accurate alignment of the complete unit.

It is expected that when the plants at Boston and Philadelphia are completed, and the pumps placed in service, considerable information will be available regarding the application of the magnetic drive as a practical means for the adjustment of pumping capacity to meet the varying rate of inflow to sewage or drainage pumping stations, or the changing service demands in a water works plant.

INSTALLATION OF LOW HEAD PUMPS

Some "Do's and Don'ts" and Other Factors for Consideration

by
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THERE would seem at first sight to be no reason why considerations in the setting of a low-head pump should differ from those for the pump for high head, for exactly the same principles apply to both and possible inefficiency of operation results, in general, from the same causes. However, the *relative* value of certain losses are much higher in the low head plant than in that for high head, and it is with this phase of the problem that the present article deals in the main.

The Author

Most low head pumps are coupled direct to their high speed electric driving motors and, as ordinarily used, such pumps are for the delivery of relatively large quantities of water, sewage, etc. Amongst a few of their most common applications are delivering water to filtration plants, moving water from one reservoir to another at a slightly different level, irrigation, lifting sewage, pumping out dry docks, supplying circulating water to condensers, cooling in general, pumping water for experimental work in hydraulic laboratories, etc. In many cases the head is under 20 ft. and, as the driver is very frequently an electric alternating current motor, with speed of 1450 rpm. or 1750 rpm., depending on the frequency of the power supply, the ordinary centrifugal pump is not suited to the purpose. Instead, a mixed-flow, or more frequently now, an axial-flow propeller type pump is used. This is more commonly true if the volume of water is large.

In the propeller type of pump the suction and discharge branches are kept as small as possible, for reasons that are obvious if the structural features of the pumps are examined. Hence, in many cases the velocities in the suction and discharge nozzles are very high. If high efficiency and low power costs in pumping are desired the losses corresponding to these high velocities must be avoided.

A Case at Point

To quote a recent case, a propeller type pump made by a builder of high reputation runs at 1450 rpm. and is designed to deliver water at a head of 22.5 ft. and, in this case, the velocities in the suction and discharge nozzles at rated delivery are 10.7 and 13.6 ft. per sec., respectively. When it is realized that the velocity head corresponding to the latter velocity is 2.88 ft., or nearly thirteen per cent (13%) of the designed head, it is seen that the efficiency of pumping will be low unless some means of recovering this head is adopted. This is one of the reasons why a distinction has been made in this article between low head and high head pumps, for if the pump had been designed for 225 ft. head instead of 22.5 ft. the same velocity head would have been relatively negligible. In practice, however, the nozzle velocities in the high head pump would often be lower than the figures quoted, which would further reduce the relative weight of the velocity head.

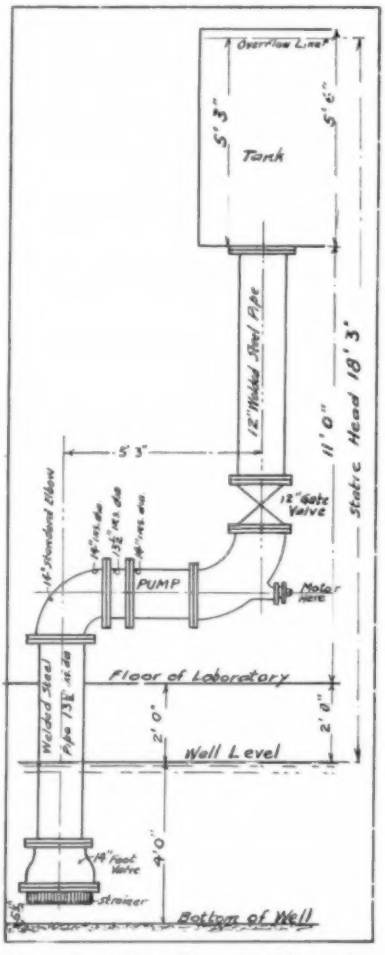


Fig. 1—Low Head Pump Installation Discussed in this Article

Similar statements apply to other features of the installation, as, for instance, the loss in a wide open gate valve of perhaps one foot would represent a four per cent (4%) loss in the low head plant, but less than one half of one per cent (0.5%) for the high head installation referred to. In the low head plant, therefore, it is necessary to keep losses in valves, bends, etc. lower than in the high head installation in order to keep the overall *percent* loss in the two cases within the same range. One of the simplest ways to do this is to keep the pipe velocity reasonably low, irrespective of the velocity at the pump nozzle.

The Matter of Short Suction and Discharge Pipes

There is another important point to be considered, and this comes up in connection with the short suction and discharge pipes that are often used on the low head plant, so that when the motor switch is opened downward flow through the pump may begin in much less than a second thereafter. Since the check valve takes an appreciable time to close, the downward velocity of the water may be high before actual closure of the check is realized. In addition, when the latter does close it often does so by slamming down on the seat and producing high, if not dangerous, water hammer pressures.

Should the check valve be on the suction side of the pump, a fault few engineers need to be warned against, the pump casing may be broken by this pressure as the designer would ordinarily only allow for a reasonable excess pressure. It is well to note

that the pressure *rise* due to water hammer may be the same for *any* head and is, therefore, a relatively higher proportion of the head for the lower values of head.

Illustrations

To illustrate these points an example is shown in Fig. 1, which represents the piping layout on a pump recently put into a new building in one of our largest public institutions. The pumping plant, for the purpose of supplying water for various purposes, consists of three propeller type pumps designed for a head of 22.5 ft. and was made by a builder of high reputation both for workmanship and hydraulic design. The pumps have capacities of 2400, 3600 and 4800 U. S. gpm. respectively, and their corresponding speeds are 2240, 1450 and 1450 rpm., the first one being driven by a V-belt and the latter two being direct connected to electric motors. The three driving motors are respectively 20, 30 and 40 hp. 550 volt, 25 cycle induction type, and stopped by a push button; as a matter of interest the specific speeds of the three pumps are 10,623, 8,421 and 9,724 based on U. S. gallons per minute. Using the design figures, the motor horsepowers correspond to an efficiency of 68% in each case, but it is probable that the efficiencies are higher than this and the larger sized motor is being used for safety.

The suction pipes of the largest and smallest pumps are only 33 in. apart, center to center, in the well, and the pipe connections for the 4800 U.S. gpm. pump are shown in detail on Fig. 1, but the others are generally similar to it. As shown, the elbow on the suction side is standard (not the preferred long radius) and is badly connected to the pump, while the welded pipes also have very rough ends. There is no check valve and the foot valve is a stock Crane 14 in. 125 lb. make. A drawing of this foot valve is being shown (Fig. 2) and an analysis, presented later, shows it to be entirely unsuited to this job. Criticism is not being made of the Crane foot-valve, but rather to the use to which it was put. All dimensions on the drawings were secured by the writer who measured the actual parts used, and such information is always procurable by anyone who wants to take the trouble to go and get it.

It is not in the least surprising that the two larger pump casings cracked when the pumps were first started, an effect undoubtedly produced by water hammer, for the setup is very favorable to it. A Crosby indicator on the suction pipe indicated a marked pressure rise when the switch was opened, but the indicator is not quick enough to show accurately what happened.

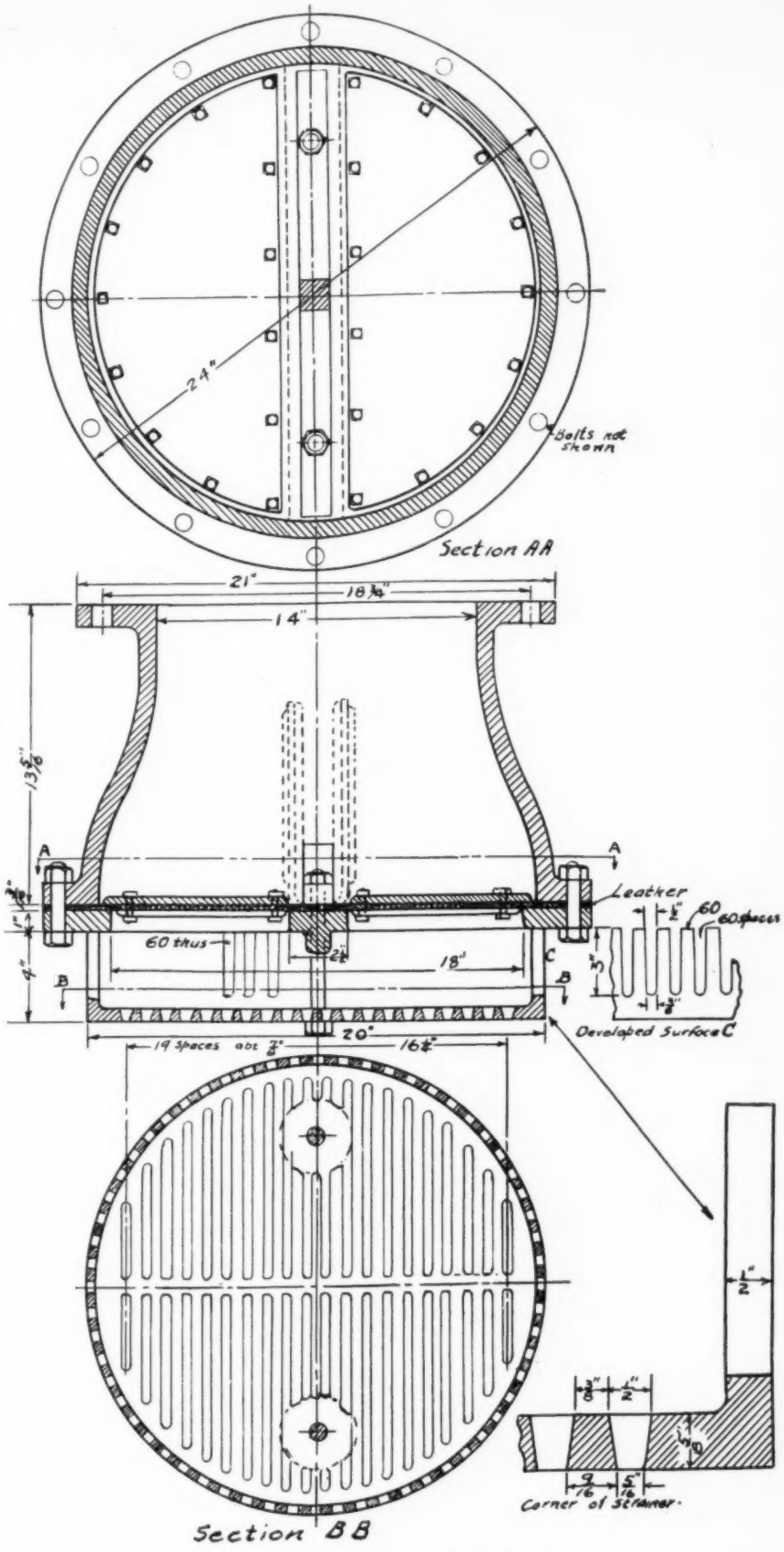


Fig. 2—14-Inch Crane, 125 lb. Foot Valve

Characteristics of Propeller Type Pumps

The characteristics of propeller pumps are fairly well known and most

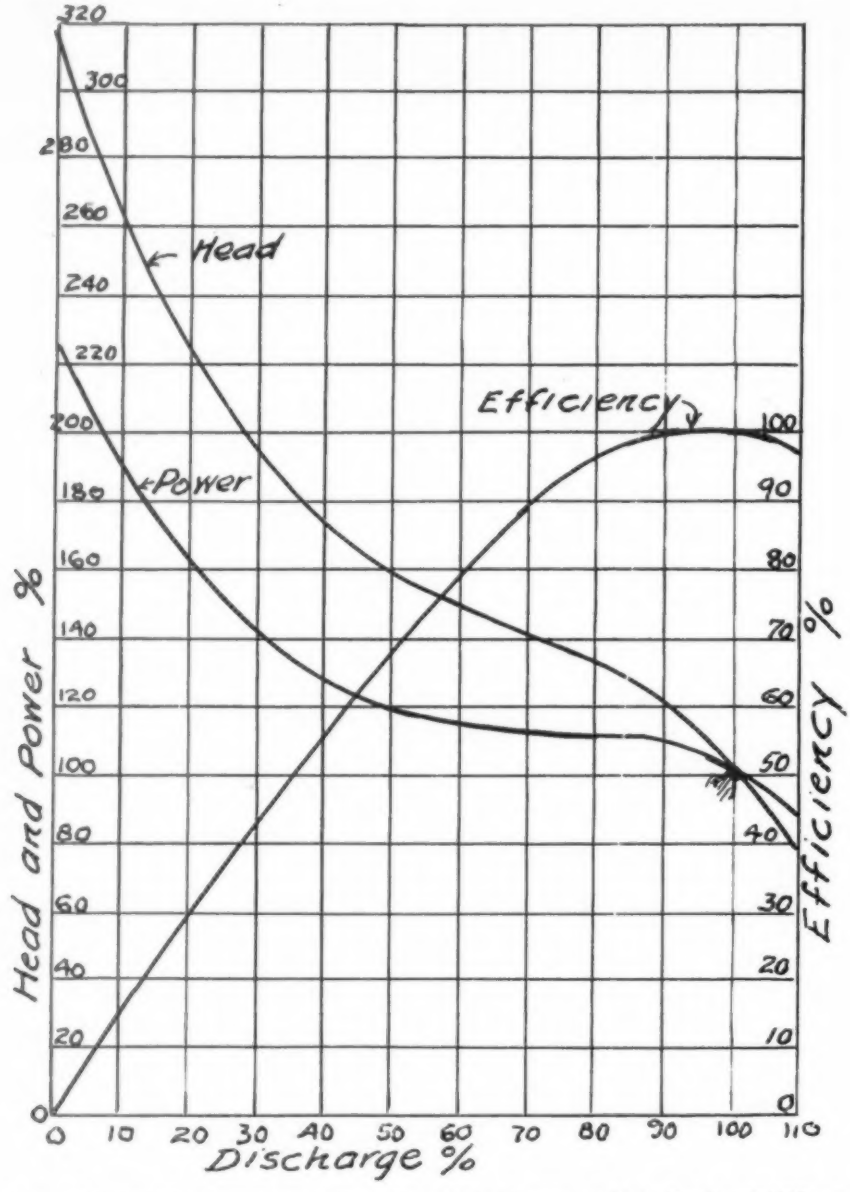


Fig. 3—Characteristic Curves on a Pump for 4,000 U. S. gpm. at 20 ft. Head and 1160 rpm.
(From tests by O'Brien and Folsom, Univ. of California.)

engineers are aware that the head-discharge curve and the power curve both rise somewhat sharply as the discharge decreases, the shut-off values frequently being over twice those at rated discharge. While test results are not so readily available for propeller pumps as for those of the centrifugal type there are enough of them to show their general tendency. In Fig. 3 curves are shown adapted from a University of California publication, "The Design of Propeller Pumps and Fans," written by Murrough P. O'Brien and Richard G. Folsom and issued in 1939. These curves are from tests made on a vertical type propeller pump with both entry and exit guide vanes and designed for 4000 U.S. gpm. at 20 ft. head and 1160 rpm. These curves show that the shut-off head is 3.15 times the normal working head, while the power required at shut-off is 2.25 times that required at rated discharge. Obviously such a pump could not be run at the rated speed with the discharge valve closed on account of the high load on the motor. Consequently, the motor switch should be opened at nearly full discharge in stopping the pump. It is further to be noted that an increase in head of twenty per cent (20%) above normal, for example, would reduce the discharge about ten per cent (10%) and at the same time increase the motor load about ten per cent (10%), features which make it necessary to operate such pumps somewhat differently from those of the centrifugal type. Because of its peculiar characteristics the propeller pump will stop almost instantaneously when the power is cut off and backward flow will start rapidly down through the pump, the velocity of the water increasing till the check valve closes.

Examination of the Actual Case Illustrated in Fig. 1

In this case the suction and discharge pipes are very short and there is no check valve except insofar as the foot valve performs this function. Without going into the rather lengthy process required for an exact solution, an approximate method indicates that if the power is cut off during normal operation the flow upward to the tank will stop in about 0.35 sec. and, if the foot valve does not stop it, water will reach a downward velocity through the pipes of two feet per second in less than one-tenth of a second. While the properties of the foot valve in this case are not accurately known it is doubtful if it could close before this downward velocity was reached, and then closure would be very quick and the valve would "slam" down on its seat with great violence suddenly cutting off the flow and producing a high water hammer pressure which could, and did, break the pump casing.

The Foot Valve. As stated earlier, no criticism is being offered here of the foot valve as such, and it is only the application of it that is being discussed. The drawing of this foot valve (Fig. 2) was made from actual measurements, but as the strainer particularly was a rough casting it was difficult to take exact measurements in some cases. The slots in the flat end of the strainer vary greatly in width and are very rough in the water passages, but their average width is estimated at 5/16 inch. Since they have a total length of 23 ft., the strainer provides an open area of 0.60 sq. ft. In addition to these slots there are, in the cylindrical surface, 60 openings having an average width of 7/16 in. and a height of 3 in. These give an additional area of 0.55 sq. ft., or a total area of 1.15 sq. ft. If, however, allowance is made for contraction of the jets through the openings the effective area of the water would be 0.863 sq. ft. even after allowing a very generous coefficient of contraction of 0.75. (The roughness of the sides prevents a very accurate value of this coefficient being chosen.)

At the rated discharge of 4800 U. S. gpm., or 10.67 cu. ft. per sec., the average velocity through the strainer openings is 10.67/0.863 or 12.36 ft. per sec., and the flow is far from evenly distributed. The turbulence resulting from the meeting of the jets through the slots with those from the side openings at right angles to them, at this high velocity, must be left to the imagination, but it certainly is not a desirable condition at the pump inlet. It is difficult to estimate accurately the loss of head in the strainer at

full flow but, considering the contraction and expansion of the small streams, the loss might be fairly taken as 2.4 ft., which is the velocity head corresponding to the velocity 12.36 ft. per sec. To this must be added the loss through the valve itself, which for want of better information is taken as one foot, making a total loss of 3.4 ft. in the foot valve.

Suction Pipe and Elbow. The drawing shows that a piece of welded pipe 7 in. long is placed between the suction flange of the pump and the 14 in. standard (not the desirable long radius) elbow, the ends of this short piece being rough and with inward projecting burrs, and the same is true of both ends of the vertical 13½ in. pipe. The loss between the foot valve and the suction flange of the pump is estimated at 1.3 ft., making a total loss of 4.7 ft. on the suction side of the pump. Adding to this the velocity head of 1.8 ft. in the 13½ in. pipe, gives a total lift at the centre line of the pump of 10.8 ft. as compared with a static lift of 4.3 ft.

Discharge Piping. Bolted to the discharge side of the pump is a 12 in. Crane gate valve and from it there is a short piece of 12 in. welded pipe running up to the tank above (Fig. 2). As the velocity in the discharge pipe is 13.6 ft. per sec., the loss at the discharge end would be the velocity head of 2.9 ft. corresponding to this velocity. Then the estimated loss of 0.9 ft. in the open valve and in the pipe brings the total loss up to 3.8 ft. on the discharge side of the pump.

Total Head on the Pump. The static head on the plant varies somewhat but may be taken as 18.3 ft. and if to this is added the losses on the suction and discharge sides the head is increased to 18.3 + 4.7 + 3.8 or 26.8 ft. Thus the friction losses amount to nearly 46% of the static head, and shows how serious the relative losses may be on a low head plant and what a large proportion of the total power may be lost in this way. Had the foot valve been replaced by a bell mouth entry, the standard elbow and short pipe by a long radius elbow, the 12 in. discharge pipe by a tapering piece having a diameter of 18 in. at the tank and with a light type of flap valve at the top of it, the total losses would have been reduced to 2.6 ft. instead of the 8.5 ft. in the existing arrangement. By the use of a very simple device and with the co-operation of the operator the loss in the check or flap valve at the outlet could be made negligible. If the flap valve loss is eliminated the total friction loss in the revised design would be only approximately 1.6 ft.

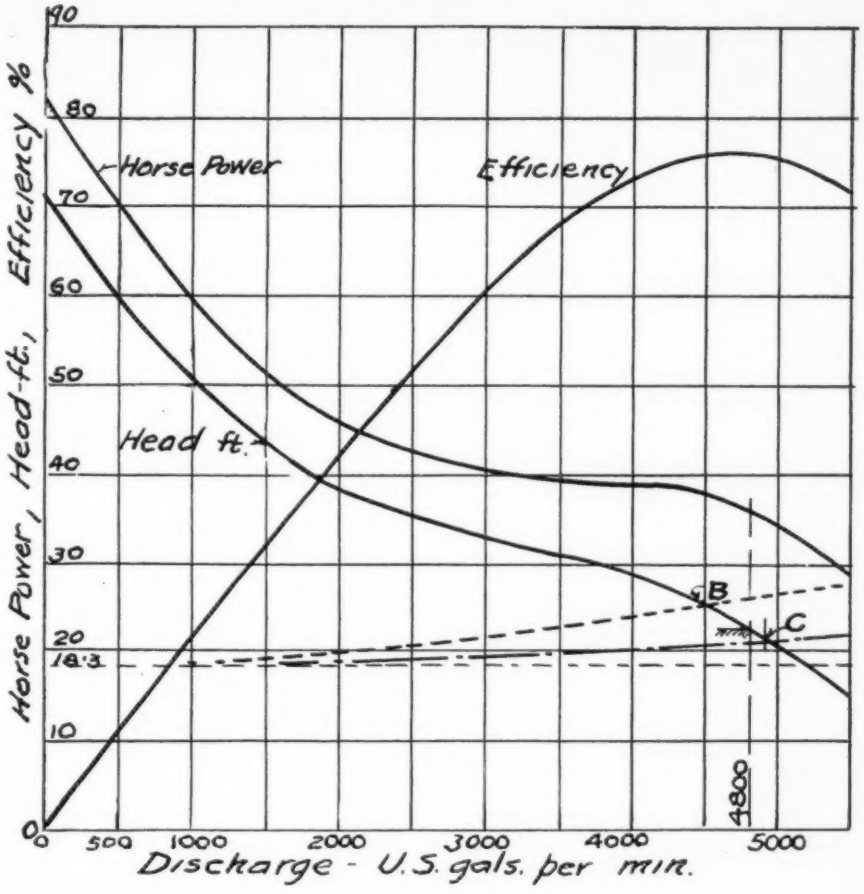


Fig. 4—Curves for Pump Installation Shown in Fig. 1

(Dotted line through B is the resistance curve for installation as designed. Dot and dash line through C is the resistance curve with improved suction and discharge piping.)

Actual Performance of the Pump

The friction and other losses already calculated are based on the assumption of full discharge of 4800 gpm., but the pump as installed cannot give this output. In the absence of the actual characteristic curves for the pump the writer has made the assumption that those given in Fig. 3 may be used as they are for a pump of nearly the same size. However, the curves are for a pump with both entry and exit guide vanes, while the pump being examined has exit guide vanes only. As only a small part of these curves at their extreme right hand ends affect this discussion, the curves are probably reliable for this purpose. Parts of the curves in Fig. 3 have been redrawn in Fig. 4 to suit the design conditions for the present pump when set as shown in Fig. 1.

The power curve is based on an efficiency at rated delivery of 76%, although this is probably low, and this corresponds to 36 hp. at 4800 gpm. and 22.5 ft. head. In Fig. 4 two other curves are also shown, the one in short dots giving the resistance against which the pump as actually installed has to work, while the curve in a dash and dot line shows the corresponding curve for the improved piping suggested, allowing also for loss in the check valve. The delivery points are marked B and C respectively, for the two cases and it is evident from them that the pump as installed could only give about 4500 gpm., or 94% of rated capacity, and would require over 38 hp. to drive it under this condition. With the improved piping the discharge would exceed 4900 gpm. and the power required to drive it would be about 35 hp. Of course, with the improved piping a priming device would have to be used but there are various simple arrangements and inquiry shows that one suitable for all three of the pumps would cost about the same as only one of the foot valves in use now.

Water Hammer in the Pump

It has already been pointed out in this article that if the pump being considered is giving its full discharge when the power is cut off, downward flow through the pump will reach a velocity of 2 ft. per sec. in less than half a second thereafter, provided the check valve (in this case the foot valve) does not close rapidly enough to prevent it. With this type of valve it seems probable that such velocity would actually be reached before the

valve slammed down on its seat. The pressure *rise* resulting therefrom would be in the neighborhood of 85 psi., producing a pressure in the pump casing of about ten times normal, and it is not surprising that the casing cracked when the pump was first run. It is hard for some people to realize that water hammer is much more apt to be destructive in pumps with short piping and low heads than it is in any other type pump installations.

Unfortunately this plant has been so designed as to facilitate the entry of large volumes of air into the suction pipes of the three pumps and this fact, combined with the further fact that the strainers are less than six inches above the floor of the well and that the foot valve on the pump discussed is less than a foot from the foot valve on the small pump, and that one of the 14 in. foot valves is within three inches of the wall of the well, all militate against the pumps giving their rated discharges even if head was not over that designed for.

This plant, which has so recently come to the writer's notice, and the details and general arrangement of which were unknown to him until after the pumps were damaged, has been used as an example to show how important a matter it is to pay close attention to *all details* in planning a low head pumping installation.

Dappert Appointed Exec. Secy. N. Y. State Water Pollution Control Bd.

Announcement has been made of the appointment of A. F. Dappert as Executive Secretary of the New

York State Water Pollution Control Board, which was created last April by the N.Y. State Legislature after a study of more than two years.

Mr. Dappert, a native of Illinois, and a graduate of the University of Illinois in 1920, with a Master of Science in Sanitary Engineering in 1927 from Harvard, has been with the N.Y. State Health Dept. since his early association with the Illinois State Health Dept.

Since 1930 Mr. Dappert has been Principal Sanitary Engineer of the N.Y. State Health Dept. During World War I he rose from private to First Lieutenant in the Tank Corps and saw service in France. In World War II he was assigned to the staff of Admiral Nimitz as Army Sanitary Engineer representative for Military Government in the Pacific Theater of Operations. He was discharged from duty as a Lt. Colonel and returned to the N.Y. State Health Dept.

In his new position as administrative agent of the Water Pollution Control Board, his chief task will be to develop the water pollution control program in New York State.

Utica Sewer Gas Brings Suits

Fifty-four Utica residents have filed claims against the city, seeking a total of $286,500 damages for illness and injuries they alleged to have suffered from sewer gas.

Federation Convention To Have 29 Exhibitors

The following 29 firms as members of the Water & Sewage Works Mfrs. Ass'n, have taken exhibit space and will be represented at the forthcoming Convention of the Federation of Sewage Works Associations at the Hotel Statler, Boston, Oct. 17-19.

American City Mag.
American Well Works
Builders-Providence, Inc.
Carter Co., (Ralph B.)
Chain Belt Co.
Chicago Pump Co.
Cloroben Corp.
Dorr Company, Inc.
Engineering News-Record
Flexible Sewer Rod Equip. Co.
Hardinge Co.
Infilco Inc.
Jeffrey Manufacturing Co.
Johns-Manville
Link-Belt Co.
Lock Joint Pipe Co.
Pacific Flush-Tank Co.
Preload Companies
Public Works Mag.
Sewage Works Eng.
Simplex Valve & Meter Co.
Vapor Recovery Systems Co.
Walker Process Equip., Inc.
Wallace & Tiernan Co., Inc.
Warren Pipe Co., Inc.
Water & Sewage Works
Westinghouse Electric Corp.
Worthington Pump & Mach. Corp.
Yeomans Brothers Co.

Sodium Silico-Fluoride Will Save Money in Fluoridation

Having determined that fluoridation of the city water supply of Milwaukee with sodium fluoride was to cost the city $98,000 per year, the use of sodium silico-fluoride as a substitute for the more expensive sodium fluoride is being considered by the Milwaukee Health Dept. and the Water Dept.

Sodium silico-fluoride is a by-product from the manufacture of phosphates from certain phosphate rock. Being a far less costly product, it is estimated that water fluoridation with the silico-fluoride will cost about 2¼ cents per capita per year as compared to 14 cents at Milwaukee if sodium fluoride is employed.

Although the silico-fluoride has not so far been used elsewhere in water treatment, Dr. E. R. Krumbiegel, Milwaukee's Health Commissioner, has been quoted as stating that "current data indicates that the use of the less costly silico-fluoride may be feasible."—J.E.H.

Almon L. Fales Dies

Almon L. Fales, longtime partner in the consulting engineering firm of Metcalf and Eddy, Boston, died August 19, after an illness of several months.

A graduate of Worcester Polytechnic Institute in 1898 with a B.S. in chemistry, he rose from Asst. Chemist to Superintendent and Director of Testing Laboratories in the Sewage Treatment Works of Worcester. In 1913 he joined the consulting engineering firm of Metcalf and Eddy in Boston, from which he retired as an active partner in 1948 due to ill health.

Mr. Fales was a leading authority in the country on the subjects of sanitary engineering, stream pollution and industrial waste treatment. In both world wars, he served the government in a consulting capacity with respect to sewage disposal methods at army camps, and the treatment of wastes from ordnance plants.

Mr. Fales was the author of many articles in the technical and scientific press. He was a member of A.S.C.E., A.W.W.A., A.C.S., N.E.W.W.A., and the Boston Soc. of Civ. Engrs.

RAPID SAND FILTER DESIGN AND MAINTENANCE*

by
A. H. ULLRICH
Supt. Water and Sewage Treatment
AUSTIN, TEXAS

VIEWED from a purely elemental standpoint, the essential parts of any rapid sand filter plant are as follows:

1. Filter box
2. Underdrain system
3. Filter media
4. Wash water troughs and gullets
5. Pipe gallery, consisting of
   a. Influent valve and piping
   b. Effluent valve and piping
   c. Waste valve and piping
   d. Wash water valve and piping
   e. Rewash valve and piping
   f. Rate of flow controller
   g. Rate of flow gage mechanism
   h. Loss of head gage mechanism
6. Wash water tank or pump
7. Wash water rate controller
8. Surface washing system
9. Clear-well

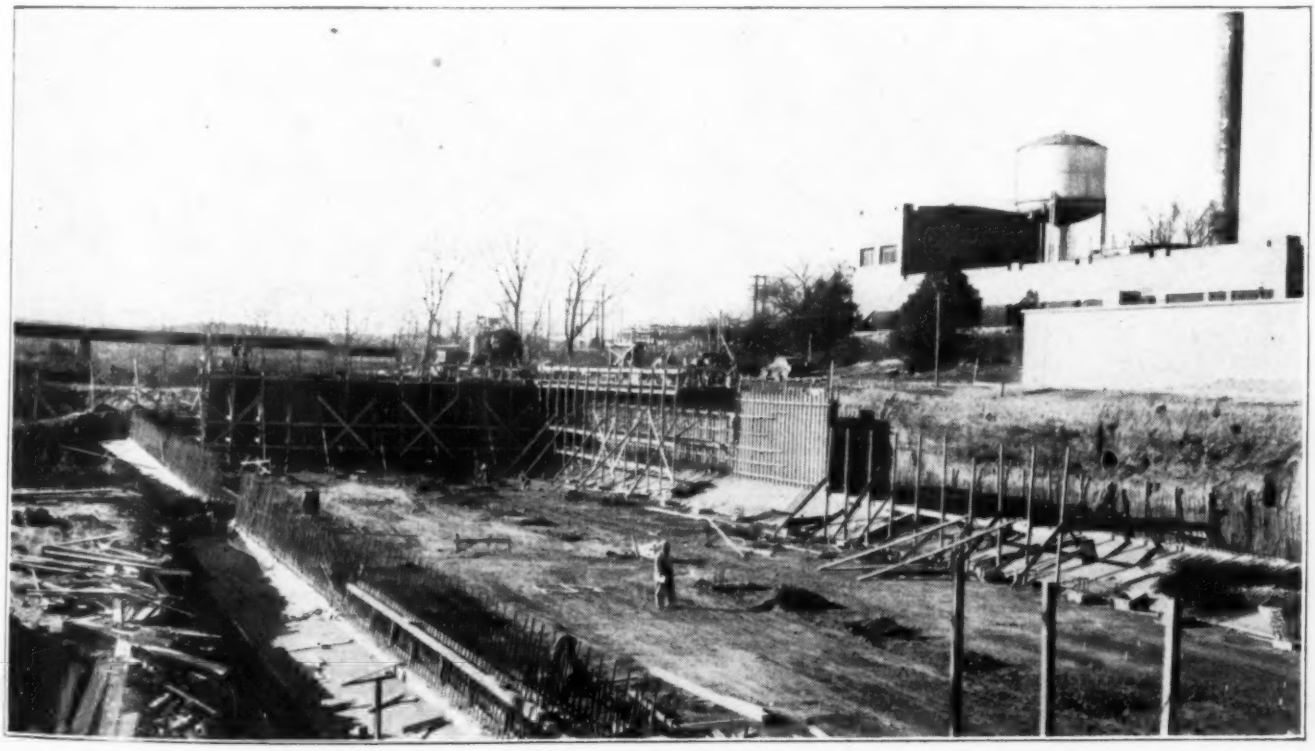
The detailed design of each component part as listed above, as well as the detailed design of the plant as a whole will depend on the total filtering capacity desired, on the type water to be treated, on the type treatment the water is to receive prior to filtration, and to other local considerations. The basic principles governing detailed designs are pretty well established, and it is, of course, the design engineer's responsibility to meet the local needs. While it is not in the province of this paper to discuss detailed designs, the writer would like to offer a few observations which, in his opinion, have a direct bearing on the maintenance and operation of the plant. It is freely admitted that some of the observations on design which follow may contain a few personal beliefs and prejudices. They are given, however, in the hope that an instructive open discussion may follow.

*A paper read before the Texas Water & Sewage Works Short School.

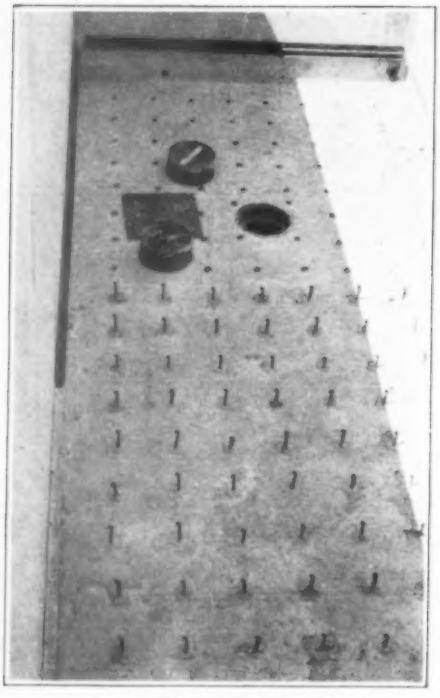
The Author

Filter Boxes

The maximum filtering capacity to be provided will, of course, determine the total cross-sectional area which the filters must have. If we assume a standard filtering rate of two gallons per square foot of filter area per minute and must provide a given number of gallons of filtered water per minute, then it is a simple matter to arrive at the required total filter area. The important decision which the design engineer must make is into how many units to divide the required area. His decision should be based on a balance of economy of design as against flexibility of operation. The writer believes that even the smallest plants should have at least two filter units, so that one unit may be taken out of service for repairs while the other unit is still



Addition of a 3,000,000 Gal. Clear-Well to the 800,000 Gal. Clear-Well at the Austin Plant.
An important addition to increase flexibility of plant operation and smooth out load fluctuations on the filters and chemical treatment facilities.



Bottom of Filter Box—First Stage
Before pouring piers to support porous filter bottom plates. Note supporting angle iron around walls.

in operation. In designing filters for larger plants, the design engineer must balance the cost of not only the filter boxes but also the cost of the control valves and piping, rate of flow controllers, wash water facilities and other appurtenances, against flexibility of operation. Another factor to consider is that if the plant is ever expected to expand, any additional units that are added will almost of necessity be of the same size as the original units unless separate wash water and waste facilities are provided.

Incidentally, in recent years some of us have had to exceed by a material margin the former standard filtering rate of two gallons per square foot of filter area per minute. While this higher rate has proven to be safe practice where we have maintained an applied water of good quality and have maintained our filter beds in good condition, it is our opinion that the two gallon rate is still sound practice in new plant design. This conservative design will provide an added factor of safety should the plant be required to take on an increased load before it can be expanded. Such has been well proven during both World Wars, particularly during World War II.

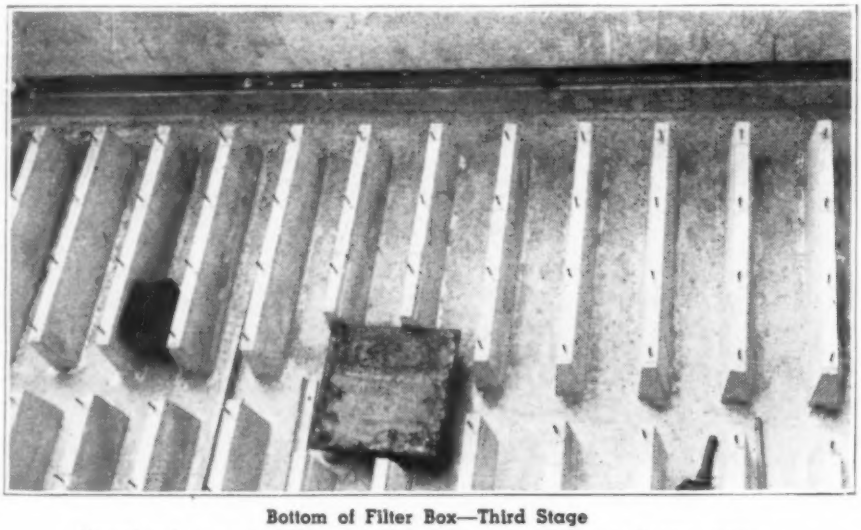
Filter Underdrain System

Sometime ago a representative of a filter equipment manufacturer informed us that his firm had devised the perfect underdrain system. Perhaps we operators are looking for the impossible, but it is nice to dream of perfect underdrain systems. However, we doubt that any truly perfect has been built as of the present writing.

In Austin we now have in use three different types of underdrain systems; namely, Infilco's Wagner Blocks, Builder's manifold and lateral system using coarse media between the laterals, and Carborundum Co.'s "Aloxite" brand porous plates. Since Austin has practiced lime softening without recarbonation for over twenty years, and is still using this method of treatment, there is considerable incrustation of the filter media as well as the underdrain system. This probably requires us to carry on a more extensive filter maintenance program than would otherwise be required. But such maintenance work has other distinct advantages, and, in addition, gives us a pretty good opportunity for studying different types of filter construction. In our plant we have had very good service from both the Wagner Block type underdrain and Builder's conventional manifold and lateral system. The chief objection to both of these types of underdrain is that various sizes of coarse media are still required to support the fine material, and the coarse particles have a habit of getting mixed with the fine particles. All of you have probably had the experience of having fine material work down into the coarse material and have, no doubt, even had it work down into the laterals of some filters. Also, if any work is done on the filter bed, it is very difficult to keep the various sizes from getting mixed. If for any reason the filter media must be removed for work on the underdrain system, then it must be regraded before it can be returned to the filter box. This, as you who have experience know, is a tedious and expensive job.

Bottom of Filter Box—Second Stage
Forms in place for pouring concrete piers.

The porous plate type underdrain eliminates the mixing of the various sizes of media since only the fine grade of media is required. Such a filter bed will withstand more abuse from air binding, and resulting explosive wash, and excessive filter runs, without permanent damage to the bed. Also, if it is desired to clean the filter bed, it can be vigorously agitated with water or air or both, or it can be shoveled back and forth in the filter box. Before becoming associated with the Austin plant, the writer had excellent results from the use of porous bottom plates at Fort Smith, Arkansas,



Bottom of Filter Box—Third Stage
Completed concrete piers ready for placement of porous bottom plates.

where a soft mountain lake water was coagulated, settled, and filtered. The Austin plant had two porous plate bottom filters when the writer became associated with it something over a year ago, and we installed three additional porous plate filters in 1948. Because of the carbonate incrustation obtained with our present method of treating, it appears likely that we will be required to clean the plates with muriatic acid at some as yet undetermined intervals. We cleaned the plates in the two original porous plate filters with muriatic acid last spring, merely as a safety factor for last summer's load. These are outside filters and were not originally equipped with loss of head and rate of flow gages. Since we are just now getting them so equipped, we have not been able to record any material increase in the loss of head through the plates. At the present time it appears that carbonate incrustation will *not* be a serious problem, because our experience last year demonstrated the ease with which the plates can be uncovered, treated with muriatic acid, washed, and the filter returned to service. The cleaning procedure was to shovel all the filter media from one end of the filter to the other, treat the exposed plates, wash the filter, and repeat the procedure for the other end.

Filter Media

While the title of this paper is "Rapid Sand Filter Design and Maintenance," a more appropriate title would probably be "The Design and Maintenance of Rapid Filters." As all of you know, many plants now use "Anthrafilt" instead of sand for the fine media; and, many plants also use coarse anthrafilt instead of gravel for the coarse supporting material. "Anthrafilt" is, of course, the trade name of the filter media prepared from crushed and graded anthracite coal. Opinions are still divided as to the relative merits of sand and "Anthrafilt," probably because each seems to have a definite field in which it excels. The writer has had excellent results using sand with an effective size of approximately 0.45 mm. in filtering soft, coagulated, and settled water where the chief problem was removal of colloidal clay and color. It is doubtful that the standard "Anthrafilt" which has an effective size of 0.60-0.80 mm. would have given equally good results. In the Austin plant, we are using standard "Anthrafilt" for filtering lime softened and settled water and are obtaining good results. The material which we are using has an effective size of 0.60-0.80 mm., and it is probable that sand with a similar effective size would also give good results. One of the chief and valid arguments for the use of "Anthrafilt" is that its specific gravity is less than that of sand and, therefore, the wash water rise required for adequate bed expansion is less for "Anthrafilt."

Bottom of Filter Box—Final Stage

Completing the porous bottom by bolting down the plates and pointing up spaces between plate edges.

In Austin where we have incrustation of the media particles, the importance of this factor is reduced because the calcium carbonate film which forms on the surface of each particle increases the specific gravity of the "Anthrafilt" particle. We have found that in some of our older filter beds the fine "Anthrafilt" carried a coating of calcium carbonate which was as high as 75% of the total weight of the media, but was still doing a good job.

The writer's experience, so far, indicates that when using sand an effective size of from 0.40 mm. to 0.50 mm. probably makes the best filter media for use with soft water which is difficult to coagulate and settle. Highly turbid waters and waters containing colloidal clay and color probably come in this category also. On the other hand, the larger "Anthrafilt" seems to have an advantage where lime softened water or water which is easily coagulated and settled is to be filtered.

Air Binding and Bed Cracking

The type of water which results from the preparation given it ahead of the filters will determine the best methods of operation and maintenance to employ in keeping our filter beds in first class condition. Soft waters, high in colloidal clay, color, or algae concentrations, are sometimes difficult to coagulate and settle, and the resulting excessive floc carry over may cause rapid filter clogging. If filters are permitted to become too dirty, the fine media will probably develop cracks and will likely pull away from the filter box walls. This will permit floc to penetrate the beds so deeply that it will become difficult to wash the filters clean. Also, if the surfaces of the beds become badly clogged, the filters will often become air bound. When a filter with a tightly packed surface layer and air in the underdrain and lower layers is washed, there is excellent opportunity for disrupting the entire bed, resulting in mixing the sand and gravel or the coarse "Anthrafilt" with the fine. The writer believes that, if at all possible, filters should always be washed before there is any appreciable amount of air binding. If air binding does begin to show up in the filters, then it is good practice to reduce the length of filter runs and establish a lower loss of head for filter washing. If there is appreciable air binding, the filter should be removed from service and the air permitted to escape as much as possible before turning in the wash water. If the air will not escape rapidly enough after the water level is lowered on the bed, then it should be worked out slowly by just "cracking" the wash water valve before washing.

Length of Filter Runs

In lime softening plants, and in other plants where a very clear applied water is often obtainable, it may be possible to keep filters in operation for long periods between washings without air binding, without appreciable loss of head build-up, and without a drop in the rate of flow. How long a filter should be operated thus, with a clear applied water, will depend on local conditions. In Austin, where we filter an incrusting water, we now feel that excessively long filter runs cause binding and lumping of the filter media. In other words, we believe that if the filter bed is not agitated and washed often enough, the sand or "Anthrafilt" particles will become cemented together by the incrusting material so that washing will not completely break them apart. We have not yet arrived at what we believe the maximum filter run should be in our case, but it now appears

that it will not be in excess of 72 hours. We have three new filters which will be used for the first time this year, and we plan to place each on a different maximum run schedule to try to determine the maximum safe run.

The length of filter runs to be used at a given plant involves the type and quality of applied water which can be obtained at the plant. Obviously, the filter runs should also vary with variations in the quality of the applied water as well as with variations in the filtering rate. Filter wash water costs money; and, good practice dictates that we make our filter runs as long as possible without endangering the quality of our effluent or cause damage to our filter beds. In this connection, we should remember that filters are installed for the purpose of removing impurities which are not removed by prior treatment. If excessive filter runs tend to defeat this purpose, either because of damage to the beds or because of deterioration of accumulated organic matter, then we need to shorten our runs. Likewise, if our filter beds have been in service so long that they will no longer function satisfactorily, then they should be replaced with new material.

Wash Water Troughs and Gullets

The design of wash water troughs and gullets has become so well standardized that they are mentioned here only in passing as being necessary parts of a filter. However, there is reason to believe that study might be given to the arrangement of the troughs, looking toward improved filter washing.

Pipe Gallery

In designing a filter pipe gallery, special care should be exercised by the design engineer to provide ample room for ready access to all valves, rate controllers, loss of head and rate of flow gages, so that they may be easily inspected, maintained, and repaired. The installation of filter control valves should be made under careful inspection, as the writer has known of horizontal valves being installed upside down and vertical valves with downstream guides being installed backwards.

The writer believes it to be good practice to provide adequate lighting in the pipe gallery—even to painting the walls and ceiling white—in order to encourage good maintenance of the control valves, controllers, gages, and other equipment. Where hydraulic filter control valves are used, care should be exercised in selecting the best possible packing. It is difficult to stop leakage with poor packing, and there is danger of scarring the valve stems and of causing sluggish valve operation if the packing is too tight.

Wash Water Tank or Pump

The design engineer must exercise his judgment as to whether to provide a wash water tank or a pump. The writer has always been prejudiced in favor of a tank, but he realizes that a properly designed pump can do an adequate job. Backwashing with water from a force main through pressure reducing valve has usually not been successful, even in small plants. Where wash water tanks are provided, it is usually good economy to install a low head pump for pumping water into the tank and also, to provide a standby connection from a force main for use in case of pump failure.

Wash Water Rate Controller

Wash water rate controllers are helpful in assuring a uniform washing rate. If properly adjusted and in good working order, they are a good protection to the filter bed.

Surface Washing System

Perhaps one of the best investments that a filter plant can make for protection of the filter bed is the installation of a well-designed surface washing system in each filter. The writer knows of no better method for keeping filter beds clean and for eliminating mud ball formation than the proper use of a good surface washing system. Either the patented Palmer "Filter Sweep" or the Baylis stationary type surface wash system will give good results.

Clear Well

Aside from meeting Fire Underwriters' requirements on filtered water storage capacity, the clear well capacity should be sufficient to give maximum flexibility to the plant. From a plant operation standpoint the ideal clear well should be large enough to permit the entire plant to operate at a fairly uniform rate during each twenty-four hour period. The nearer this ideal is approached, the nearer will the entire plant be in position to operate at maximum capacity. It is because of this that the Austin clear well is being substantially enlarged at this writing.

Unusual Consulting Engineer's Brochure

Entitled "It Can Be Done," an unusual 20-page brochure has been issued by Parker & Hill, consulting engineers, of Seattle, Wash. This brochure contains descriptive case histories of individual water and sewer systems, water storage, sewage treatment plants, platting and street improvement projects. The book contains photographs and factual details describing each step in the engineering, construction and financing of projects ranging from a sewage treatment plant for a town of 5,000 to water storage facilities involving a million gallon concrete reservoir. A brief summary with each case history highlights costs, population served, quantities, financing, and charges to users.

By means of this brochure, Parker & Hill point out that "seemingly unsurmountable problems of public understanding, divergent interests or equitable distribution of costs can be solved by qualified planning."

Those Vortexes Again

Yes, Madam—those vortexes can be very dangerous at times. It's a water spout in reverse, you know.

Allegheny County Sanitary Authority To Proceed

Pittsburgh Makes Monies Available

The City Council of Pittsburgh, Pa., has passed legislation making available $2,100,000 in city funds to the Allegheny County Sanitary Authority. The city loan is to be used by the Authority to prepare detailed construction plans and specifications for a sewage treatment system for Pittsburgh and 42 adjacent communities.

This action on the part of the City of Pittsburgh followed notice issued in May by the Sanitary Water Board of Pennsylvania, requiring the city to inform the Board of June 20 "how the city intends to meet the Board's requirements that it abate the discharge of its sanitary sewage wastes," in compliance with a previously issued order.

OPERATION OF SMALL WATER PLANTS

Billing and Collection

by

A. E. CLARK

General Manager

NASHVILLE SUBURBAN UTILITY DISTRICT

NASHVILLE, TENN.

THE operation of small water works varies little from the procedures used in the large systems, except in size and number. This is true of financial operations of a water system which fall into one of three classifications: 1) private ownership-operating for a profit, 2) municipal ownership-operating for a profit, many times for the benefit of other municipal departments, and 3) non-profit water districts, where excess funds are used only for operation, improvements, or reduction in rates.

The Author

Billing Operations

Regardless of the type of system, billing is a most important part of operation. The period of billing varies from monthly to quarterly and depends somewhat on the number of consumers. Obviously, it is much easier and requires less time to bill 500 consumers monthly than 5000. If there are 5000 consumers, it is easier to divide the area into three zones, making meter readings in one zone each month. In this way, the consumers are billed quarterly, but bills for one zone are sent out each month.

The date of billing depends on completion of the meter reading, one suggested procedure is to start billing as soon as the first meter book is received in the office and continue until completed. All bills can then be sent out on the same day each month, say, for example, the 15th. This gives time between completion of the meter reading and billing to recheck high meter readings, etc., and correct bills, where necessary, before the mailing date.

Every effort should be made to keep billing costs as low as possible, but in doing this there will be a minimum below which it is impossible to go without leaving off some of the necessary information.

The post card bill has been found very satisfactory and only costs one cent to mail. In addition, there is the cost of approximately 0.3c per card for printing, while addressing costs will vary depending on the method used, whether addressing on the typewriter or using one of the addressing machines. The cost of addressing using an addressing machine is usually figured over a period of 8-10 years, including a yearly service charge on the equipment. On this basis the cost is very low as compared to typing. It is also necessary to take the time element into consideration. One clerk doing some of the routine office work can also type about 400 addresses a day; while using the addressing machine the same clerk can address an equal number in one hour. The post card bill which the writer has found satisfactory is shown in Fig. 1. It is noted that the space between the name of the district and actual bill is used for some comment to the consumer such as the one illustrated regarding leakage. It is planned to change this every six months.

Billing Records

What is the simplest and most informative record of the billing to be kept in the office? Three methods are in general use: 1) register sheets, 2) stub plan, and 3) individual ledger sheets. The type of record to be kept depends somewhat on the manager or superintendent in charge and to some extent on procedures with which he is familiar.

The register sheet plan eliminates the customers' ledger and registers a number of bills on one sheet as does also the stub plan which substitutes a copy of the bill for the customers' ledger. Both of the above are used in many utility offices and each has its merits.

The writer favors the individual ledger sheet because among other advantages it carries a history of each connection for a period of 6 to 8 years. Properly filed, a customer's account is readily and quickly available. Fig. 2 shows a ledger sheet used by the writer. The particular feature of this sheet is that at the top all pertinent information in regard to the connection and occupant is given. The remainder of the sheet is similiar to any other ledger sheet used for this purpose. The sheet used is the tumbler type so that both sides can be used and covers a period of six years by quarters. When used in conjunction with a billing machine, this sheet has been found very satisfactory. The post card and sheet being placed in the machine, meter readings, amounts, etc., are typed on the card and at the same time are automatically typed on the ledger sheet. The machine also carries totals of information typed. For a relatively small number of accounts, hand posting can be done, but for any number of consumers this is a costly and time-consuming process.

Payment Periods

Bills should be sent out promptly each month and at the same time for any particular zone. Many consumers budget their money and therefore want to make the necessary allocation for utility expenses. Net payment periods are of three kinds: 1) after expiration of net payment peri- all amounts net, 2) actual discount on gross bill, and 3) penalty payment after net payment period expires. Regardless of system used, particularly discount and penalty methods, it should be on a uniform basis; that is, if there are exceptions then they should be adopted as policies to be applied in each particular instance. As an example, if a consumer is allowed to pay the net once or some specified number of times a year, when payment was not made within the specified time limit, then this should be a definite policy. There is nothing which will make a person more angry than to let him believe that an exception has been made in one case and not in his, assuming the same conditions obtained. This applies throughout the billing and collecting. Uniform policies applicable to all the consumers should be adopt-

NASHVILLE SUBURBAN UTILITY DISTRICT
929 THIRD NATIONAL BANK BUILDING
NASHVILLE 3, TENN.
PHONE 5-7543

Let us remind you—a leaking faucet can waste as much as 133 cubic feet of water a day. A washer, a wrench and screw driver is all that is needed to stop a leaking faucet

Water Bill
PHONE 5-7543
Date Meter Read

Last Net Payment Date
25th Day of this month
This Stub Must Accompany Remittance

Previous Read.	Present Read.	Water Used (Hund. Cu. Ft.)	Gross	Net	Gross	Net

CUT STUB ON THIS LINE

Fig. 1.—Post Card Bill

ed and adhered to, otherwise there will be numerous complaints. At the best there are enough complaints without deliberately adding something more which would increase them.

Policies and Public Relations

How a consumer should be billed sometimes poses a question. If, for instance, on monthly billing he has moved into a house on the 20th of the month and has used less than the minimum allowed, would he be billed for the whole month on a minimum basis or on a half month or wait until the second month which would be one month and 10 or 11 days. For such a situation, there should be a specific policy, so the billing clerk will know how to bill.

Meter books are usually checked, after reading, for dead and slow meters as well as high readings. Orders should be issued to change all dead and presumably slow meters. In the case of high readings, there should be a policy to determine the cause unless there is something obvious which the meter reader has noted in the book.

In the case of dead meters, what instructions should be given the billing clerk in regard to billing these consumers? Should they be billed an average of their previous readings if these are available, or might they be billed for the same quantity used the previous year during the same reading period? Should the bill show that the quantity for which they are billed is estimated or should they be billed and nothing said about it? The above questions are important and some procedure should be set up for these cases.

Other questions are often asked, "Was the meter read?" "Was the meter read correctly?" This brings up the question of over-reading which is bound to occur but not very frequently. How is this handled? If the consumer pays the obviously high bill and on the next reading it is found that the consumer still has a credit balance, is he notified that the meter was over-read and a full explanation given to him? In case he complains in regard to his bill and an immediate check shows that it was over-read, how should this be handled? The confidence of the consumer in the integrity of the utility is most important. The writer believes in making a proper explanation to the consumer so that he understands and in that way has confidence in the utility.

Delinquent Accounts

If a discount or net payment period is used what procedure is followed to collect the bills not paid within the discount or net payment period? Do the bills become delinquent at the end of the period or is the time extended 15 or 30 days, when the gross bill becomes due? At the end of the extended time when the bills become due and payable what means or methods are used for the collection of these bills? The writer mails a notice to each delinquent consumer in a sealed envelope, giving the amount due, and stating

BOOK NO. 15 | CODE NO. 2-2145 | LOCATION 715 Lombardy Avenue | METER SIZE 5/8 | TAG NO. 5642

DATE SERVICE BEGAN	CONSUMER	DATE SERVICE ENDED	DATE OF DEPOSIT	AMT. DEP.	REFUNDED DATE	REFUNDED AMT.	REMARKS FOR. ADDRESS
11-1-48	John H. Smedley		11-1-48	5.00			

DATE OF BILLING	REMARKS (OR ACCT. NO.)	METER READING	WATER USED	GROSS	NET	PENALTY	DATE	CREDITS	BALANCE
READING FORWARDED		742		BALANCE FORWARDED					
FEB 1'49		774	32	956	892		FEB 1'49		892 TOT
						64	FEB 25'49		956 TOT
							~~FEB 29'49~~	892	64 TOT

NASHVILLE SUBURBAN UTILITY DISTRICT

Fig. 2.—Ledger Sheet Billing Record Used by Nashville Suburban Utility

that five days are allowed in which the bill is to be paid or satisfactory arrangements made with the office.

Every means is used to collect delinquent bills and still try to make the consumer feel that he should pay it without leading him to believe that he is being pressed. The telephone is successfully used to a considerable extent. A personal request couched in proper terms over the telephone usually brings results and many times apologies from the consumer for not having paid his bill on time. Sometimes there are reasons why a bill has not been paid and these are always taken into consideration when collecting delinquent accounts. It is well to defer discontinuing service until all other means of collecting have been exhausted. As a last resort the collector goes to the residence with a copy of the bill and his shut-off wrench. This will usually bring results. The number of delinquent accounts can be kept to a minimum if handled properly, but it does require some thought and study, because we are all human and liable to misplace or forget to pay a bill and sometimes run short of cash.

The billing clerk or clerks must be familiar with the policies, otherwise the number of complaints will increase. Procedures must be set up to take care of changes in address or consumers moving away. In recent years, this problem has been particularly trying due to the large number of new residences being constructed as well as sales and resales of houses. Sometimes a new consumer is no sooner set up on the ledger sheet and the address plate made than notification is received that he is moving and the house sold to another party. Such occurrences have been responsible for errors in billing since there are times when a person has moved out without notifying the water utility.

Another difficult situation occurs when after completion of a residence, a builder will fail to notify the water utility that it is sold. He will continue to be billed and that usually brings him into the office.

The use of water and service rendered by the utility are just as much an obligation of the consumer as any other commodity he might purchase. If he purchases groceries, the store at which the purchase is made expects payment. The purchase of water is exactly the same and the utility expects payment for the water used even though it is the cheapest commodity he purchases.

J. W. Gittins Acting Secretary, Pa. Sanitary Water Bd.

Announcement has been made of the appointment of John W. Gittins of Kingston, Pa., to the position of acting secretary of the Sanitary Water Board of the State of Pennsylvania. Mr. Gittins was formerly assistant district engineer in the Wilkes-Barre office of the Bureau of Engineering of the State Department of Health. He succeeds William A. Gorman, Harrisburg, who has accepted the position of Public Health engineer with the U.S.P.H.S., working out of the New York Office in the Middle Atlantic Drainage Basin.

Mr. Gittins became a member of the Bureau staff in 1945 after having taught school in Kingston for 11 years. He served 13 months in the Navy during the war.

Oh, Yea?

Under the caption "Liquor Saves the Day" the following news item came out of Dawson in the Yukon.

DAWSON, Yukon.—Muddy flood water seeping into the city's water supply system forced residents today to turn to liquor as their only drinking supply.

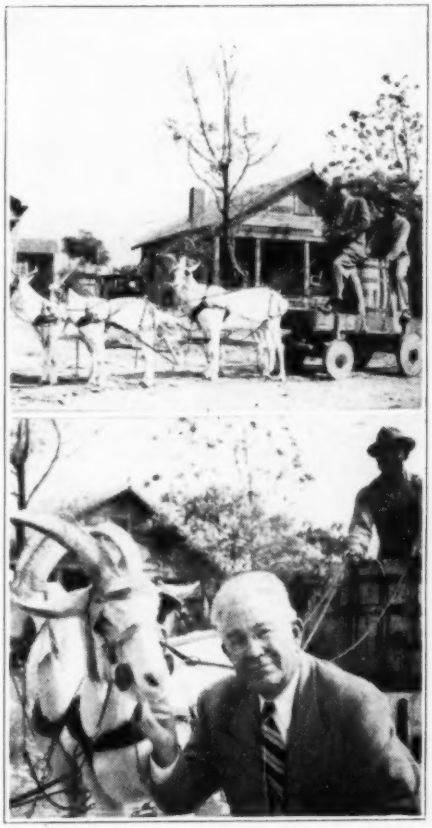
WATER PURVEYOR—1949

All of the following exists on the fringe of Shreveport, La., where "Tom" is Thos. L. Amiss, Supt. of Water and Sewerage.

"Ed" is the proud owner of this handsome foursome of goats and the water cart with which he makes a living peddling the "elixir of life," drawn from a free-hydrant on Tom Amiss' water system and sold throughout a colored section on the outskirts of Shreveport.

These snapshots were made by E. L. Filby of Kansas City, who ran upon this outfit delivering water. And, after razzing Tom, prevailed upon him to pose with "the other four goats," as Tom put it.

Tom explains that 2½ inch G.I. pipe for extensions hasn't been easy to get under 18 months in Shreveport; and, "anyway, even goats have to eat."



Karo; Eagle; Abel and Cain—Plus Tom; Ed. and His Water Cart.

Sewer Damage Suit

What is thought to be one of the largest judgments handed down in any court in connection with damage to a sewer was that won by the City of Cudahy, about ten miles to the south of Milwaukee. Cudahy won a judgment of $83,897.30 in the circuit court in August against the Ladish Co., one of the largest drop forge plants in Wisconsin.

The damage claimed was reported to be due to the acid wastes which the company permitted to leak from the plant's sewer system into the city's storm sewer, damaging it a distance of 714 feet along the north side of the Ladish plant. The acid waste, it is claimed, also corroded an additional length of 3,403 feet of the storm sewer. All of this, according to the claims of the City of Cudahy, makes it necessary to replace large sections of sewer pipe in the vicinity of the Ladish plant. The main claim was that the company had been remiss in inspection of its sewer system at the plant.—J.E.H.

NEW YORK'S 40-YR. OLD INFILTRATION GALLERIES

Found to Need No Repairs and Functioning More Efficiently Than When Installed

NEW York City is in the process of replacing pumping stations along their infiltration gallery lines in Nassau. In giving the gallery system a thorough investigation before repairs, it came to light that the 40-year-old vitrified clay pipe gallery itself required no repairs whatsoever. Records indicated that over the past years the galleries have actually increased in efficiency, securing more water from underground sources today than they did in their first years of operation.

Description of Gallery Construction

About forty years ago, the Department of Water Supply, Gas & Electricity of the City of New York constructed its Massapequa and Wantagh infiltration galleries of vitrified clay pipe in the southeast portion of Nassau County, Long Island, and ever since, whenever the needs of the city require their use, has pumped a supply of 18 and 12 million gallons daily, respectively, from these galleries.

The Massapequa gallery consists of approximately 18,000 lineal feet of vitrified clay pipe varying in size from 20 to 36 inches in diameter. The Wantagh gallery is similarly constructed but is only 12,000 feet in length. The two galleries are located adjacent to each other and together intercept the underground water flow for a distance of almost six miles along the south shore of the Island. The works are located about three-quarters of a mile north of tidewater and about ten miles south of the watershed divide of the Island.

Fig. 1 shows a plan of the galleries and the lengths and sizes of clay pipe used. This clay pipe was laid in open trench and the joints between the sections of the pipe were left open, no calking material being used. About each joint was placed a quantity of fine gravel to permit water to enter the pipe and to keep out the fine sands in which the gallery was constructed.

Pump wells were located at the mid-point of each gallery. The lines of clay pipe were pitched toward these pump wells from each end with a slope of approximately 0.05 per cent. The original pumping stations were constructed immediately adjacent to the pump well. In operation, the pumps in the pumping station lower the water level in the pump well, allowing the water in the clay pipes to flow into the pump well, and water from the sandy soil to enter the pipes. Approximately 1 mgd. can be secured continuously from each thousand feet of pipe or about 30 mgd. for the two galleries.

At the pump well the vitrified clay pipe was laid beneath the surface with about 16 feet of cover, and at this point on the gallery the ground water stands approximately at the ground surface. It is therefore possible to create a lowering of almost 16 feet immediately above the galleries for a longitudinal distance of nearly six miles. The average ground cover over the clay lines is about 20 feet.

The Water Table

The section of Long Island in which these galleries are constructed is a glacial outwash plain, and the material consists of medium size gravel, coarse, and fine sand. The water table rises from approximately sea level at the south shore of the Island to about 65 feet above sea level at the watershed divide.

The effects of gallery operation on the ground water levels have been noticed as much as 6,000 feet upstream when they are in continuous operation. Salt water intrusion from the salt beds to the south is prevented by the maintenance of a secondary divide between the gallery and the salt water of the Bay. This divide is kept about two feet above sea level during continuous operation. Fig. 2 shows, diagrammatically, the changes which occur in ground water levels due to operation of the galleries.

Some months ago, the City of New York awarded contracts for the electrification and modernization of the pumping stations which are used to operate these two galleries, a contract for the work having been awarded to the Afgo Engineering Company and the Pipe Engineering Company jointly in the amount of $248,780.00.

The original stations were each equipped with three steam driven centrifugal pumps, those of Massapequa having capacities of 10 mgd. each and those at Wantagh 6 mgd. each. The contract included the demolition of the existing buildings, the construction of new buildings, and the installation therein of new electrically driven centrifugal pumps. The new buildings are to be constructed directly over the existing pump wells instead of adjacent thereto. The contract provided that the existing steam driven pumps be kept in operation during the period of new construction. Savings in operating costs are ex-

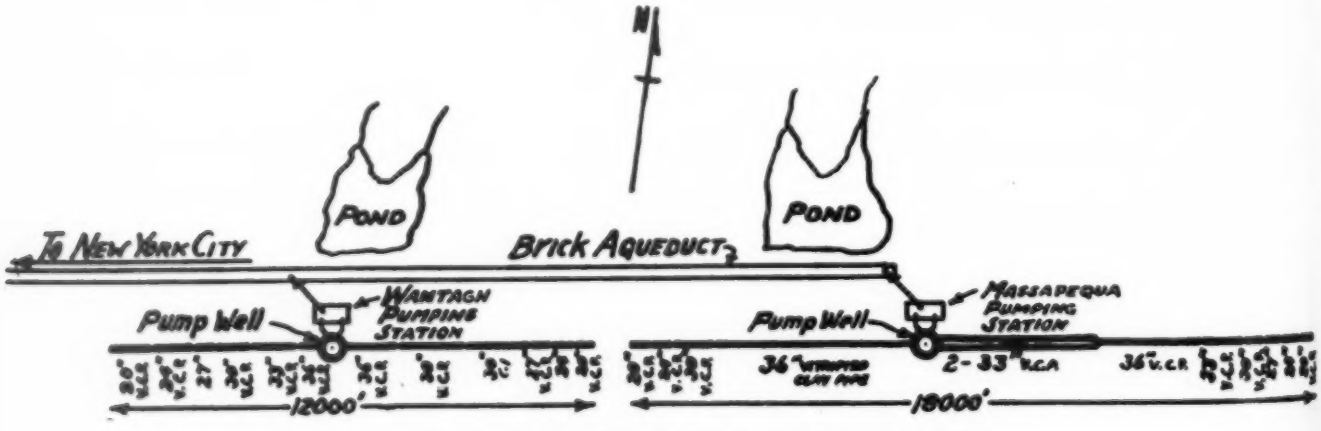


Fig. 1.—Plan of Galleries Showing Lengths and Sizes of Clay Pipe

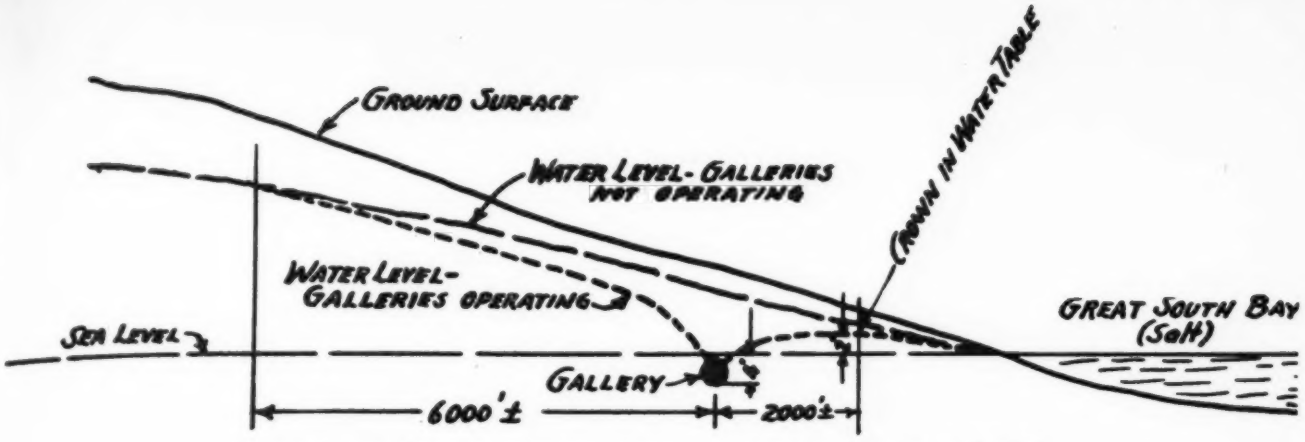


Fig. 2.—Changes Which Occur In Ground Water Levels Due to Operation of Galleries

pected to pay for the new installation in less than three years of continuous operation.

Gallery Yield Has Increased

There is every indication that these clay pipe galleries have not depreciated during their forty years of use, but actually that their capacity to deliver water to the pumps has increased slightly. It is interesting to find that, although the original buildings have deteriorated to the extent where they must be replaced and the pumps and prime-movers have become obsolete during the years, the clay lines which are the essential part of the system have maintained their full efficiency.

Hon. William O'Dwyer is Mayor of the City of New York. Stephen J. Carney is Commissioner of the Department of Water Supply, Gas and Electricity, and Edward J. Clark is Chief Engineer of the Bureau of Water Supply.

G. H. Dunstan Joins U. S. P. H. S. In Alaska

Gilbert H. Dunstan, Associate Professor of Sanitary Engineering, at the University of Alabama, Tus-

caloosa, Ala., since 1938, has resigned to accept the position of Sanitary Engineer in the Alaska Health & Sanitation Activities Division of the U.S. Public Health Service.

Professor Dunstan is now located at Fairbanks, Alaska, and has direct responsibility in sanitation research, water and sewage disposal for the Alaska Health Sanitation Activities Division.

NORTHEASTERN OHIO CONFERENCE ON SEWAGE TREATMENT

Diamond Alkali Co. Acts as Host

More than 130 men from a wide area of Ohio attended the August 13 meeting of the Northeastern Ohio Conference on Sewage Treatment. Feature of the meeting was an inspection of the Diamond chlorine producing plant.

Tours of the plant were under the supervision of Steve Puschaver, Asst. Supt. of Diamond's Chlorine Division. Following dinner at the Richmond Valley Inn, Mr. Puschaver spoke comprehensively on the production and handling of chlorine. A question and answer period followed, and the program concluded with motion pictures supplied by Sherwin-Williams Co. and the Firestone Rubber Co.

President of the Northeastern Ohio Conference on Sewage Treatment is John Barrett of Cleveland, Ohio.

J. E. McKEE APPOINTED SANITARY ENGINEERING PROF. AT CAL. TECH.

The California Institute of Technology has announced the appointment of Dr. J. E. McKee of the consulting engineering firm of Camp, Dresser & McKee, Boston, Mass., as Assoc. Prof. of Sanitary Engineering, effective with the fall term.

Dr. McKee received his undergraduate training at Carnegie Institute of Technology and his master's and doctor's degree in sanitary engineering at Harvard Univ. Prior to joining the consulting engineering firm he was employed by the TVA and the U.S. Public Health Service. During the war he served with the Army Engineers at Salt Lake City and in Europe as a Major.

Although Dr. McKee will withdraw as an active partner from the firm, he will retain affiliation with it, continuing to assist on problems of stream pollution and industrial waste research.

OBTAINING A RATE INCREASE

In Which Good Public Relations Paid Off

by
CHAS. J. ALFKE
Exec. Vice President
HACKENSACK WATER CO.
WEEHAWKEN, N. J.

THE Hackensack Water Company, a privately owned water utility, serves 53 municipalities in Bergen and Hudson Counties in northern New Jersey, with a population of about 500,000 people.

Following is a brief description of the preparation and the presentation of the facts in connection with the recent application of the Company for increased rates.

The Company decided in the latter part of 1948 that increased net earnings were necessary to provide a reasonable return on its property investment. Funds will have to be secured for the purpose of making additions and replacements to property in order to maintain sufficient plant capacity to render adequate service.

The last rate increase secured was in 1929. Since that date, increased revenues and decreased carrying charges had not kept pace with increased taxes and operating expenses.

Preparations in Advance of Application

The staff of the Company prepared an allocation study of property and expenses for the purpose of arriving at a basis for allocating the requisite increase in revenue to service districts and types of service.

The laws of the State of New Jersey and the regulations of the Public Utility Commissioners relative to rate case proceedings were carefully followed by the Company in presenting its case.

In order to meet the requirements of the Commission, notification of the Company's intention to raise rates, and the amount thereof, was given to all customers.

Officials of municipalities served were notified of the Company's intention, either verbally or by telephone, and also by letter. They were also advised of the amount involved. Likewise, all large industrial customers were advised, verbally and by letter.

Domestic customers were furnished with a pamphlet giving details and reasons for the increase in rates. All newspapers in the territory were provided with press releases and also paid advertisements were placed in the newspapers.

The Author

All of this contacting was done before the application for the increase in rates was filed. The material stated that the increase was the first in twenty years; that decreases in interest charges and economies practiced had enabled the Company to go along for twenty years without a request for an increase in rates; that the rate of return had been low for the past seven years; and that the increase would actually amount to *less than a penny a day to the average consumer.*

Filing of the Application

The application for increased rates filed with the Public Utility Commissioners contained the new schedule of rates; a comparison of the old schedule of rates with the new schedule; also financial statements, and a list of the municipalities in which the Company provides service; and the information the Company wished to get in the record. Hearings were materially simplified, and a decision expedited by this procedure.

At the hearings, testimony of one of the Company's officers was submitted to present the Company's results of operations in the past seven years, and to serve as a prognostication of the results for 1949. Testimony of consultants was employed to get into the record the rate of return required by the Company, and the method of allocation of property and expenses used to determine the new rates for the different service districts and classes of service. The case, including direct and cross-examination, required only three hearing days.

Probably because of the good public relations of the Company and the fact that the customers were given complete information in advance of the filing of the petition, objection to the increase was not serious.

Good Public Relations Pay Off

The Company, for many years, has maintained a Central Service Bureau, available by phone twenty-four hours a day and seven days a week, to receive inquiries or complaints from customers. It has been the Company's policy to handle such inquiries or complaints, without delay and in a business-like way, in order to impress on its customers the fact that it is interested in giving good service.

The Company's employees have been trained to give good service to its customers. The officers of the Company for years have given considerable attention to the Company's public relations. Cases involving increased rates will proceed faster and better results will be accomplished if a Company is enjoying good public relations and has been producing a product of good quality. The latter is, in fact, one of the first requirements in any successful attempt to develop satisfactory public relations.

Some Important Points

To summarize, very briefly, the experience of the writer in relation to handling rate cases brings out the following important points:

1. Prepare the figures in the case so as to be truly helpful to the Commissioners and Staff of the Public Utility Commission.
2. Use the best informed officers and employees of the Company for testifying, wherever possible.
3. Advise the customers of the intention to raise rates and the amount involved. Likewise, fully advise Municipal Officials and newspapers in the territory.
4. Maintain good public relations, *always*. It pays off.

RAPID METHODS FOR TOTAL HARDNESS IN WATER

by
J. R. ROSSUM AND PRIMO VILLARRUZ
CALIFORNIA WATER SERVICE CO.
SAN JOSE, CALIF.

THE need for a rapid means of measuring the hardness of water supplies is felt most keenly, perhaps, by operators of softening plants where the raw water is subject to sudden fluctuations in quality. A satisfactory method must enable one to distinguish between calcium and magnesium hardness, and should be subject to an error not exceeding five per cent.

The Soap Method

For several years we have been sporadically investigating the soap method. Trials of various solvents led us to the conclusion that c.p. methanol best met the requirements. Our stock solution is prepared by dissolving 100 grams of "pure castile soap" powder in a liter of methanol. After standing at least overnight, the supernatant is diluted with methanol until one ml. of soap solution is equivalent to one miligram of calcium as $CaCO_3$. The resulting solution of essentially pure sodium oleate is stable for at least a year at room temperatures.

In elaborating on the work of Brown and Villarruz [1], reactions of the soap solution with calcium and magnesium were found to be quite different. While each equivalent of soap reacted with one equivalent of calcium, the amount of soap required to react with one equivalent of magnesium was found to vary with the amount of calcium present, the pH, the strength of the soap solution, and to a certain extent, the time required to complete the titration. The variation with calcium was empirically expressed by an equation in the following form:

$$\text{Log Soap} = (a + \frac{Ca}{b} \log Mg + c - \frac{Ca}{d} \quad \text{Eq. (1)}$$

where a, b, c, and d, are constants whose value depends upon the pH, the strength of the soap solution, and the technic of the individual analyst. The term "Soap" in the above equation represents the volume of soap solution required to reach the magnesium endpoint after the calcium endpoint has been reached.

Borate buffer is used to establish the pH as in the method of Langelier.[2] Five ml. of a 20 gram per liter tetraborate solution is added to 50 ml. of the water to be tested in a 4 ounce oil sample bottle. Soap solution is added from a 5 ml. burette in small increments, shaking after each addition, until a ring of curds, or perhaps small bubbles, is noted around the entire circumference of the oil sample bottle as it rests in a vertical position. This white ring is the calcium endpoint, and it is best viewed against a black background with the light falling obliquely from above. Although this endpoint is sharp enough to determine within 0.05 ml. of soap solution, it is fairly easy to overrun.

Magnesium Endpoint

Our efforts to find a magnesium endpoint of comparable sharpness to the calcium endpoint have been unsuccessful. Experience led us to adopt a lather about ¼ inch high (with the oil sample bottle in a vertical position) that was stable for sixty seconds, after violent shaking for about three seconds. The lather is made up of very fine bubbles since the larger bubbles break after five or ten seconds. If stable for sixty seconds, it will generally be found to be stable for several hours.

A number of precautions must be observed while making the soap test. Shaking must be uniform, and the increments of solution added must be very small near the endpoints. Not more than 5 ml. of soap may be used, so that samples having a hardness in excess of 100 ppm. as $CaCO_3$ require dilution. Titrations must proceed at a reasonably uniform rate. All oil sample bottles used should have a uniform diameter. On the whole, considerable experience is required before optimum results can be obtained.

In our computations no "lather factor" or blank is deducted. Calcium is obtained from the product of the volume of soap solution used and its strength. Magnesium is obtained from a nomograph based on the equation above, since this equation is too complicated for direct solution. Values for the constants in the equation are:

$$a = 0.803$$
$$b = 216$$
$$d = 124$$

where both magnesium and calcium are expressed in ppm. as $CaCO_3$. The constant "c" will have to be determined for each soap solution by each individual for his own use. Total hardness, of course, is the sum of the calcium and magnesium hardnesses.

The preceding discussion indicates that while calcium can be conveniently and accurately determined by the soap method, the determination of magnesium requires considerable skill and experience on the part of the analyst. While this is true, it should be noted that a "green" operator, who had never used a burette before, was obtaining very satisfactory results using the soap method after an hour or two of instruction from an experienced analyst.

We want to call attention to what we feel is an advantage of the soap test that has been generally overlooked. When a domestic consumer inquires about the hardness of a water supply, he frequently wants to know, within rather wide limits, "How much soap do I have to add to a given volume of water to obtain suds for washing?" Because of the complicated relation that pH, calcium, and magnesium bear to the soap consuming power of the water, this question can manifestly be answered more directly and accurately by the soap test than by any other method for total hardness.

Titan Yellow for Magnesium

Our experience with the titan yellow colorimetric method for magnesium[3] has been very disappointing. Many of our tests are made on waters containing 50 ppm. or more of silica which appears to interfere seriously with the method. We were not successful in attempts to apply a correction for this error as suggested by Bengolea and Amato,[4] and even under the most favorable conditions we found the method to have no appreciable advantage over the soap method as outlined above.

Preliminary tests on the chloranilic acid method for calcium[5] indicated the method to lack sufficient sensitivity without first concentrating the water. Our soap method again seemed to be much more satisfactory.

Schwarzenbach Titration

The Schwarzenbach titration for hardness[6] has proven itself to have several advantages over the soap method. This method uses versenate (the disodium salt of ethylenediaminetetra-acetic acid) as a volumetric reagent in the presence of an indicator known as Eriochrome-schwartz T (dye F241) and an ammonium chloride — ammonia buffer. The indicator changes sharply from pink to blue in daylight, and from pink to almost colorless in artificial light. The reagents, as well as literature describing the method and chemistry involved in detail are available from the Hach Chemical and Oxygen Co. of Ames, Iowa.

Although the endpoint of this titration is satisfactorily sharp, it is somewhat delayed. Until considerable experience is gained, when testing a water of unknown hardness, the analyst will frequently overrun the endpoint, although he will readily recognize that he has done so. The error may be eliminated by repeating the titration and proceeding more slowly in the vicinity of the endpoint, or by back-titration with standard calcium chloride solution. For field use, for the use of filter and softening plant operators, we have adopted a simple procedure that overcomes this difficulty. The required volume of water, usually 50 ml., is measured into a graduated cylinder of the proper capacity. Approximately 80 per cent of this water is then poured into an erlenmeyer flask, the dye and the buffer added, and the versenate is added rapidly until the blue color appears. The remainder of the water is then added and the solution returns to the original pink shade. The titration is resumed, slowly and carefully, until the final endpoint is reached. This procedure has been found to be highly satisfactory.

The separate determination of calcium and magnesium is accomplished readily by precipitating the calcium with ammonium oxalate, filtering, and titrating the magnesium alone with versenate. Since the buffer contains an adequate concentration of ammonium chloride, there is no tendency for magnesium to be precipitated, and the pH is high enough to insure complete precipitation of calcium. Five ml. of saturated ammonium oxalate added to 50 ml. of water and 10 ml. of buffer is enough to precipitate up to 250 ppm. of calcium (as $CaCO_3$). If a sufficiently retentive filter paper is used, the solution may be filtered without further ado, and titrated immediately. Somewhat to our surprise, it was found necessary to filter out the oxalate. The versenate forms a strong complex with calcium, and if the calcium oxalate precipitate is allowed to remain in suspension, it is very rapidly dissolved as the versine is added.

Manganese Interference

The Schwarzenbach method has been found to be very satisfactory for both magnesium and total hardness on a wide variety of natural waters occurring throughout California, with the exception of those containing an appreciable amount of manganous manganese. In relatively small quantities, even 0.1 ppm., managanese tends to cause decolorization of the indicating dye. At manganese concentrations of 0.5 ppm. or greater, this effect is so rapid as to preclude the use of the versenate method, unless certain precautions are taken. The simplest method of avoiding the interference of manganese is to measure out the required volume of water, add the buffer, and expose to the atmosphere for several hours with occasional shaking. If the manganese concentration is less than 1 ppm., the titration may then be undertaken. Iron in small concentrations has no effect. At high concentrations, the ferric hydrate floc appears to absorb an appreciable amount of dye, and the brown color of the precipitated iron is somewhat annoying. Other constituents in the waters of our experience have caused no interference, although water treated with surface active phosphates, zinc or copper in high concentrations cannot be satisfactorily tested.

A comparison of the results obtained on three typical waters is presented in the table below.

This table shows that satisfactory results can be obtained by either the soap method or the versenate method. The former, however, requires a considerable degree of rather highly specialized skill. Where the separate determinations of calcium and magnesium hardness are required, the soap method is less time-consuming since the filtration is avoided. Where the analysts are familiar with both methods, as in our central laboratory, it seems desirable to use the versenate method for total hardness and the soap method for calcium.

	No. 1	No. 2 ppm. as $CaCO_3$	No. 3
Calcium by Standard Methods	40	112	126
Calcium by Soap Method	39	113	124
Calcium by Versenate Method (a)	39	113	127
Magnesium by Standard Methods	29	40	67
Magnesium by Soap Method (b)	29	40	65
Magnesium by Versenate Method	28	41	67
Total Hardness by Standard Method (c)	69	152	193
Total Hardness by Soap Method	68	153	189
Total Hardness by Versenate Method	67	154	194

(a) Difference between Total Hardness and Magnesium by versenate method.
(b) Difference between calcium and total hardness by Soap Method.
(c) Sum of Calcium and Magnesium by the gravimetric methods outlined in "Standard Methods for the Examination of Water and Sewage," 9th Edition.

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(3) American Public Health Association, "Standard Methods for the Examination of Water and Sewage," 9th Edition.

(4) Bengolea, David J., and Amato, Fortunato D., "Determination of Magnesium in Water," *Rev. Obras Sanitarias Nacion (Arg)* **20**—71 February 1947.

(5) Barreto, A., "New Method for Colorimetric Determination of Calcium," *Rev. Quim. Ind.* (Brazil) **14** 163:18 (1945).

(6) Diehl, Harvey and Hach, Clifford C., "The Schwarzenbach Titration for Total Hardness," Available from the Hach Chemical and Oxygen Co. Box 597, Ames, Iowa. Undated.

Water Boost Fraction Of a Penny a Day

This was the newspaper heading announcing to the public, about as painlessly as anyone could wish, the granting of a rate increase to the Hackensack Water Co. which serves 53 communities in New Jersey.

The item goes on to say—"The Public Utilities Commission has granted to the company an increase of seven-tenths of a cent a day for the average family customer."

This minor rate boost, however, brings in an estimated $665,000 additional income per year to the water utility, which when referred to on the basis of cost per day per customer seems infinitesmal—and, in reality is.

A grand illustration of the old saying that "There are always at least two ways of saying anything."

INDUSTRIAL USE OF SEWAGE EFFLUENTS

How One Small City Has Profitably Sold Its Sewage Effluent

by
H. W. WHITNEY
City Manager
BIG SPRING, TEXAS

THE utilization of sewage effluents for industrial purposes is obviously dependent on two main factors; (1) a sewage treatment plant capable of producing a satisfactory effluent, and (2) the existence of industrial development in the area which can economically use the sewage effluent to advantage.

There are a number of sewage disposal plants capable of producing stable effluents which go to waste due to the absence of any demand for this water. On the other hand, there are doubtless a number of areas where sewage effluent could be economically utilized, but the existing disposal plant is not capable of producing an acceptable effluent for use by industry.

Other factors affecting this problem to a lesser degree are the availability of other sources of water, and

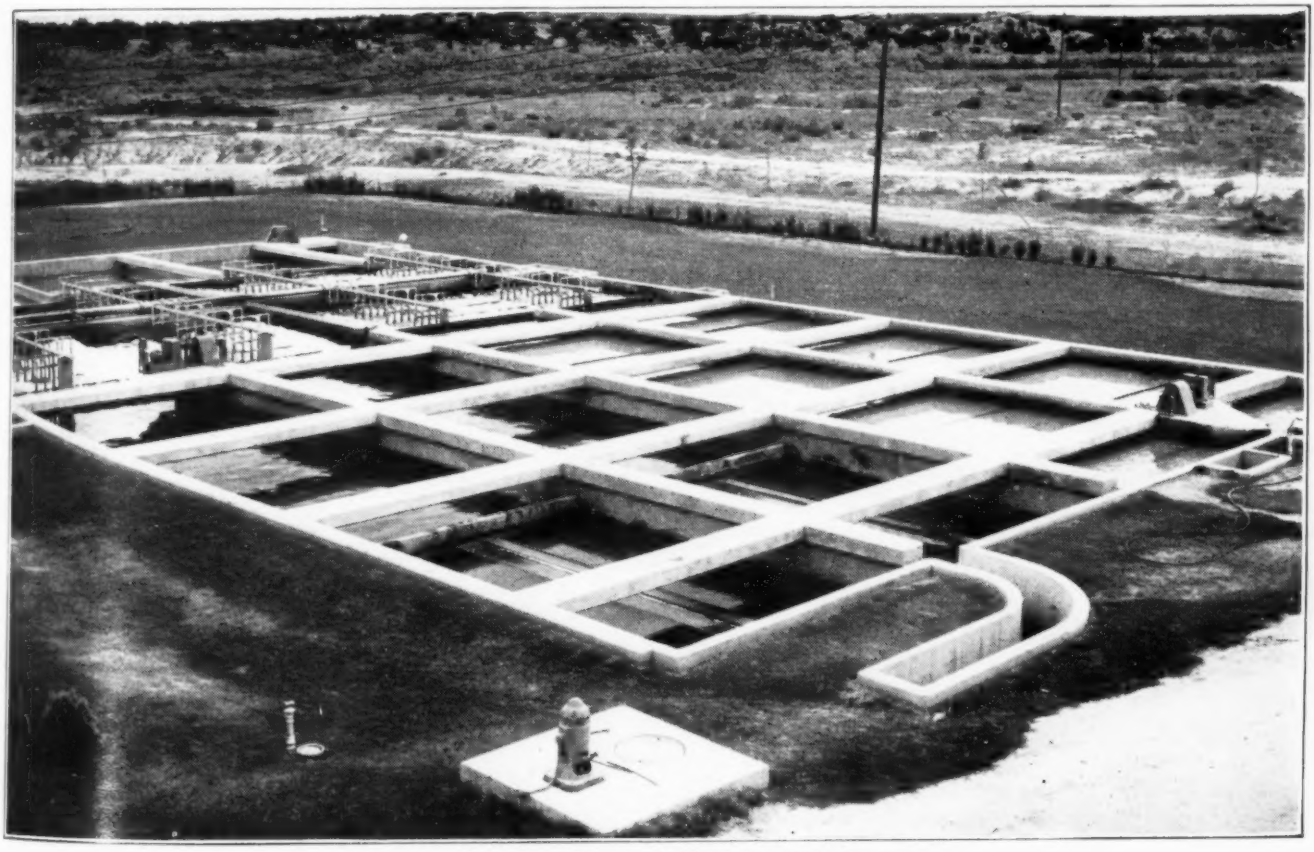
The Author

the mineral contents of such waters. In those areas where there is a plentiful supply of soft water available at a reasonable cost, there would be little demand for sewage effluent for industrial purposes.

The City of Big Spring, Texas, is fortunate in having a combination of conditions which makes the utilization of sewage effluent entirely feasible. The City has a disposal plant which produces a good effluent, there is a large petroleum refinery in the area which has a constantly increasing demand for cooling and boiler water, and the underground waters in the vicinity of the refinery are limited in quantity and also extremely high in mineral content.

The Big Spring Sewage Treatment Plant

The Big Spring Sewage Treatment Plant was constructed in 1943 at a cost of approximately $140,000 and was designed for an average flow of 1.4 million gallons per day. The incoming sewage is treated by the contact-aeration method, more commonly known as the Hayes Process. Treat-



Big Spring's Sewage Treatment Plant—1.4 Mgd. Capacity
Employs the Hayes Process, developed by Clyde Hayes of Waco, Texas.

ment consists of primary sedimentation, first stage aeration, secondary settling, second stage aeration, and final settling. At the designed flow rate, the retention period is 2.03 hours in the primary settling tanks, 1.25 hours in intermediate settling tank, and 1.74 hours in the final settling tanks, or a total retention of 5.02 hours.

In the aeration units, the sewage flows down baffle walls to the bottom of the tanks, and then up through the tanks between a series of corrugated cement-asbestos sheets, on the surfaces of which the slime-producing organisms are growing. Air supplied by three 20 hp. blowers at the rate of 1,650 cubic feet per minute is introduced into the sewage through tubular "Aloxite" air diffusers spaced beneath the contact plates. This air passes between the contact plates with the sewage and supplies the free oxygen necessary for the growth of the slime precipitating organisms. These organisms precipitate the colloids which are in the sewage and throw them out of the liquid in the form of a slime sludge. The sludge from the aeration units and from the three settling basins is pumped into a sludge digestion tank for further treatment. A detailed description of physical dimensions of this plant is given in Chapter XX of the "Manual for Sewage Plant Operators," published by the Texas Water Works & Sewerage Short School.

At the present time, the average flow entering the plant is one million gallons per day. The average biochemical oxygen demand of the raw sewage is 485 ppm. and the suspended solids are 699 ppm. After treatment, the effluent has a B.O.D. of 18 ppm. and the suspended solids are 17 ppm., or a reduction of 96.3% in B.O.D. and 97.6% of the suspended solids.

Reasons for Sale of Effluent

Prior to the construction of this treatment plant, the Cosden Petroleum Corporation obtained water for the operation of their Big Spring Refinery from numerous small wells. As the refinery was located three miles East of the City limits, water from the municipal system was not available. None of these wells has a capacity exceeding 20 gallons per minute, and in spite of continuous drilling and exploration, the supply was never adequate to meet the demands, so that the refinery was practically on a day-to-day basis of operation. The physical characteristics of the water from these wells was such that constant chemical treatment was necessary. The water was extremely hard, the soap hardness ranging from 20 to 60 grains per gallon, which caused serious difficulties to be encountered with scale deposits in pumps, water jackets and tubular equipment. This scale was of a sulphate type and extremely hard. Consultation with water treatment experts failed to develop a chemical solvent for this scale and it was necessary to chip or scrape it from the equipment. The cost of producing this water and piping it to the refinery was approximately 11 cents per thousand gallons. This cost was exclusive of the chemical treatment necessary to prepare the water for refinery use.

Upon completion of the Big Spring Treatment plant, Cosden contracted to purchase the effluent for a period of five years for use as a water supply for their refinery. This source now provides both boiler feed water and make-up water for refinery cooling purposes and has proved ample and entirely satisfactory for their purposes. The effluent is impounded in an earthen reservoir from which it is pumped as required through a 10-in. pipe line to the refinery, a distance of approximately 6,000 ft.

Quality of Effluent Covered by Contract

Cosden's contract with the City provides that the effluent shall not exceed 20 ppm. of suspended solids and 20 ppm. of biochemical oxygen demand (B.O.D.), as determined by

Plant Effluent Reservoir and Cosden Corp's. Pumps

Contract calls for effluent of not more than 20 ppm. B.O.D. or 20 ppm. suspended solids.

the Standard Methods of the American Public Health Association. The contract further provides that the City shall chlorinate the effluent to such an extent that after a contact period of 15 minutes, the chlorine residual shall be not less than 0.05 ppm. This requirement is met by the use of a W & T chlorinator which chlorinates the effluent as it leaves the final settling basin. For this effluent Cosden pays the City 5 cents per 1,000 gallons at the treatment plant, the refinery doing the pumping. Total cost of this water delivered to the refinery, including pumping costs and equipment depreciation, amounts to 7 cents per 1,000 gallons, as compared to their previous cost of 11 cents per 1,000 gallons from wells.

Advantages to Refinery

The refinery uses this effluent in three different systems; (1) a steam generating system; (2) a main process stream cooling water system; (3) a gas engine water-jacket system. The steam generating system consists of three boilers and two steam generating units, operating from the residue of the cracking units, with a total steam capacity of 79,000 pounds per hour. A hot-process water softener has been installed to treat the effluent, but there is enough soap in the effluent so that no soda ash is necessary, and treatment with a lime slurry alone reduces the hardness to 10 or 15 ppm. The use of this effluent with the water treating unit enables the boilers to remain on the line for 12 months at a time without scaling difficulties, as compared to a period of 20 to 30 days when using well water.

Similar savings were effected by the use of the effluent in the cooling processes and in the gas engine water-jackets. It was found that the efficiency of the cooling tower was increased 30% due to the elimination of the scaling difficulties formerly experienced. By using the effluent as received, no scaling occurs, and the small amount of algae growth on the tower is controlled by the occasional use of a commercial inhibitor.

Close-up of One of the Hayes Contact Aeration Units

Tubular "Aloxite" diffusers discharge 1650 cfm. of air beneath contact plates of corrugated asbestos-cement sheets.

The average cost to the refinery for water treatment chemicals was $220 per month in 1947, as compared with a $974 monthly average for the twelve months prior to the use of the treatment plant effluent. Even greater savings result from the use of this effluent due to the increased efficiency of the cooling systems and the avoidance of the expensive and frequent shut-downs which were formerly necessary to remove scale from the boilers and cooling systems.

Returns to the City

From the City's standpoint, this method of effluent disposal has been equally satisfactory. During 1948, the average cost of operating the treatment plant was $1,675 per month. During that same period, revenues from the sale of the effluent averaged $695 per month, or a reduction of 41.5% in the operating cost of the plant.

At the present time, Cosden is taking an average of 500,000 gallons per day, or about one-half the output of the treatment plant. The refinery is now being considerably enlarged, which will result in a demand for additional water, and it is believed that eventually the revenues from the sale of effluent will pay the whole of the operating costs of the disposal plant.

In Texas, and particularly in West Texas where the rain-fall is sparse and water supplies are limited, the use of sewage effluent for industrial purposes should be considered by every municipal official and sewage plant operator. Water, even in the form of sewage effluent, is too precious to waste if it can be used again.

Acknowledgment is made of an article by Gordon W. Alexander in the January, 1948, issue of *Petroleum Refiner* for certain data regarding Cosden's use of sewage effluent.—The Author.

SECOND PENNA. WATER WORKS SCHOOL

The Second Annual Pennsylvania Water Works School was held at State College, Penna., on Sept. 19-23. The short school was conducted by the School of Engineering of Pennsylvania State College and was sponsored by the Penna. Water Works Operators Assn., The Penna. Dept. of Health, and Penna. State College.

Two courses of instruction were offered. The "B" Course for persons who have attended the previous elementary course, or for persons with sufficient training and experience to warrant enrollment in the B Course. The "C" Course was, as last year, an elementary course, primarily for persons with no technical training.

The sessions were organized as regular classroom lectures and demonstrations. Assisting the Instructional Staff of Penn State were a number of sales engineers, and superintendents and engineers of water works. A total of twenty-three persons took part in the presentation of the courses. Attendance figures were not available at press time but advance registration was good.

REDUCING COSTS BY USE OF MODERN EQUIPMENT

Experiences With the Versatile "Hydrocrane"

by

REUBEN F. BROWN

Supt. Maint. and Operation
BUREAU OF SANITATION
LOS ANGELES, CALIF.

IN maintaining a sewerage system, the cost of maintenance and operation is a vital factor. The use of new and improved equipment to increase efficiency in the construction or repair of sewers is one of the things necessary for economy in Government service. Municipalities are continually faced with the necessity for reducing costs due to budget limitations. So many services are demanded by the citizens that the reduction of costs in replacing and maintaining the underground sewers and storm drain lines is of first consideration by persons responsible for doing the work.

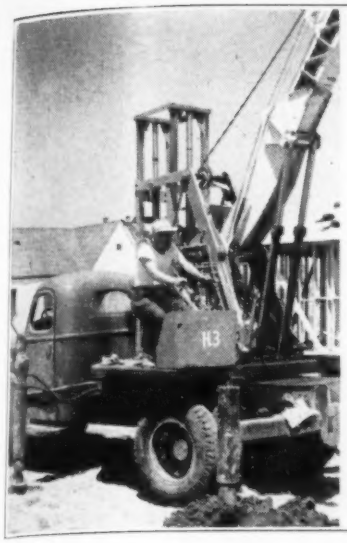
"Daredevil" Brown

A new piece of machinery effectively used in the handling of sewer pipe, in excavation of ditches, and handling of heavy machinery, is the Bucyrus-Erie "Hydrocrane." This is an hydraulically-operated crane which requires only the movement of small levers to swing the boom, and raise and lower a clam-shell. It can be moved with rapidity from one location to another. The use of the "Hydrocrane" in a number of emergency repair jobs in the City of Los Angeles has been a time-saver and has increased the efficiency of operations, thereby reducing the cost of the work.

In the replacing of over 5,000 ft. of sewer line, in adobe ground with ground water present, the "Hydrocrane" was used for trenching and manhole excavating to do the work in

"Hydrocrane" Working in Close Quarters at Heavy Traffic Intersection

Excavating a 52-in. trench across intersection and lowering of 18-in. pipe into place. Note boom retracted for close work.



Operating hand levers which extend and retract boom, operate cable and clam-shell. Note hydraulic jacks which keep crane turntable in level position.

"Hydrocrane" at Work and Results

Excavating 30 in. wide trench for 8 in. sewer. Note that crane-operator's helper places the ⅜-yard bucket in exact location for results seen in next picture.

Resulting trench with 8 in. "Ceramic-weld" clay pipe, laid in water with a flexible gasket joint. Note smoothness of trench walls and minimum of excavation.

the minimum amount of time. Some of the features that made this possible were the mobility of the equipment, the setting of the crane in position through hydraulic lifts which keep it steady, and the ability of the operator to move the bucket or the crane in trenching, or the laying of pipe, within a fraction of an inch for precision work. The ⅜-yard clam-shell bucket cuts a very excellent trench from 30 to 32 inches wide (see cut), excellent for laying 8-inch sewer pipe.

In another location this crane was used with excellent results in a heavily congested intersection of one of the main arteries of the City. It was necessary to excavate to a 25-ft. depth and construct a by-pass relief sewer line across the intersection. Hard clay and wet ground were encountered. Hand excavation would have taken at least ten days, but by the use of the "Hydrocrane" and its swinging-in effect of the clam-shell, a 52-in. trench was excavated across the intersection and the work was completed in two days. The excavating operation took 10 hours of steady work. Spring water encountered at the 20-foot level slowed down the laying of the pipe, but through use of the "Hydrocrane" the entire job was completed in record time.

Due to ease of operation, any employee who is at all mechanically inclined can learn to operate this hydraulic equipment within fifteen or twenty minutes, and become proficient with three or four hours' practice.

This is the first of a series of articles to be contributed by Mr. Brown, describing maintenance and operating methods, kinks and gadgets employed by the Bureau of Sanitation, Dept. of Public Works, Los Angeles.

The caption "Daredevil" under Mr. Brown's picture comes about as the result of an exploit by the author, in which he travelled through a dangerous gas-laden Los Angeles sewer in a one-man skiff, making a critical inspection and photographic record of the condition of the weakened structure.

We published an account of this daring exploit at the time and appended to the author the title "Daredevil" Brown. Knowing this particular sewer, we consider this title well deserved.—Ed.

The "Hydrocrane" has also proved excellent in sewer maintenance and storm drain work, for excavating between car tracks, for digging out manholes, and handling heavy equipment in pumping plants. Some of its special features are that the boom can telescope under load at the rate of 18 ft. per minute.

Lifting capacity varies from 3 tons on a 12-ft. radius to 1 ton on a 26-ft. radius. It will swing at a rate of 6 rpm. for 360°, but will not continuously revolve. Hoisting speed is 108 fpm. with a single line.

The unit is mounted on an International K-6 Truck chassis, with a total weight of 7½ tons, and can attain a road speed of 50 mph. The hydraulic equipment is operated from a power take-off on the truck.

In a demonstration of this equipment, the clam-shell bucket was laid upon a watch without breaking the crystal, showing the ease of handling and the precision with which the "Hydrocrane" can be operated.

WATER POLLUTION CONTROL ADVISORY BOARD TO MEET IN OCTOBER

Provisional Allotments of Funds Made

The second meeting of the U.S. Water Pollution Advisory Board will be held in Washington, D.C., Oct. 3-4. The meeting will review the proposed program for which funds have already been allotted.

Provisional allotments totalling $850,000 to States, Territories, and the District of Columbia have been announced by Federal Security Administrator Oscar R. Ewing. These grants are to study water pollution resulting from industrial waste pollution.

At the same time a grant of $150,000 has been made to State and interstate agencies for special studies which are of national or sectional importance. For operation, research, administration, and planning by the Public Health Service, an allotment of $1,200,000 has been made. Out of a total of $2,200,000 appropriated by the present Congress to the F.S.A. to initiate the program of water pollution control and prevention, $150,000 has not been allotted.

Before the funds may actually be released for study of industrial waste problems, applications setting forth specific programs must be approved by the Public Health Service.

EFFECT OF SCAVENGER WASTE ON ACTIVATED SLUDGE

by

GAIL P. EDWARDS,[1] W. T. CARPENTER[2] AND T. MARGOLIES[3]

Department of Public Works
CITY OF NEW YORK

THE discharge of scavenger wastes (that is, the contents of cess pools) into the sewer just outside of the Jamaica high rate activated sludge plant caused some concern as to the effect on the biological treatment process. Since the Jamaica plant has no primary settling tanks, the scavenger waste would flow almost directly to the aeration tanks without removal of settleable solids and without the added dilution in the sedimentation tanks. To ascertain possible effects of these wastes, an analytical study was made.

The trucks have a capacity of 1000 to 1800 gal. and require an average of 6 min. to discharge. As the liquid was discharged from the tank trucks, twenty composite samples of this waste were collected for analysis. The samples varied considerably but, in general, the scavenger waste is thin and watery averaging 1.6 per cent solids. With a few exceptions, the volatile solids content indicated that the material was well digested. Four samples contained considerable sand. No unpleasant smell was observed but all had the characteristic odor of well digested sludge.

[1]Chief of Laboratories, [2]Senior Chemist, [3]Junior Chemist.

Analytical Results

The total 5-day B.O.D., which averaged 1750 ppm., varied from 330 to 3800 ppm. and was roughly proportional to the volatile solids. In general, five parts of volatile solids were equivalent to one part of B.O.D. Although the soluble B.O.D. varied from 60 to 540 ppm., the average for nine samples was only 246 ppm., or about 11 per cent of the B.O.D. of the whole sample.

The chlorine demand was low and fairly consistent. It averaged 75 ppm. for ten samples. The nitrogens are low but the grease content (9.8 per cent dry basis) is slightly higher than normal for digested sludge. The average pH was 7.2.

Effect of Waste

Assuming the worst condition of a discharge of 1500 gal. of liquor having a B.O.D. of 3800 ppm. in four minutes, the B.O.D. of the sewage, assuming an average daily flow of 40 mgd., would be increased from 180 to 228 ppm. during the four-minute period. Even with twenty discharges during eight hours, the average B.O.D. for the period would increase only about 4.5 per cent or 8 ppm. It is obvious that the discharge of a moderate amount of scavenger waste at the Jamaica high rate activated sludge plant has little effect on the operation of the plant.

Such wastes discharged into small flows, however, would have a decided effect on plant operation. The analyses of the several samples are shown herewith.

SUMMARY OF NIGHT SOIL ANALYSES JAMAICA SEWAGE TREATMENT PLANT

Sample No.	Gallons Dumped	Total Solids Percent	Vol. Solids % Dry Basis	B. O. D. ppm. Total	B. O. D. ppm. Soluble	Parts B.O.D. per part Total Solids	pH	Cl. Demand ppm.	Amm. Nitrogen ppm.	Organic Nitrogen ppm.	Grease ppm. Wet Basis
1	1250	5.10	61.2	3800	540	.075	7.2				
2	1500	1.76	73.9	2800	450	.159	7.0				
3	1100	1.36	33.8	740	60	.054	.....				
4	1800	0.92	37.0	1100	490	.120	8.8				
5	1500	1.70	58.8	2300	120	.131	7.1				
6	1500	1.32	43.9	1500	.....	.114	7.8				
7	1000	2.56	54.7	3800	160	.148	7.1				
8	1000	1.68	64.3	1700	135	.101	.....				
9	1000	3.28	50.0	3300	160	.101	.....				
10	1000	0.26	30.8	370	115	.142	7.1				
11	1000	1.06	51.0	330	.....	.031	6.6	67	100	88	1040
12	1200	1.28	46.9	2200	.....	.172	7.1	71	63	87	1410
13	1200	2.74	54.0	1400	.....	.051	7.9	68	100	64	1850
14	1500	1.26	69.9	2500	.....	.020	6.5	84	64	43	2670
15	1500	0.28	57.1	500	.....	.018	7.1	71	56	110	293
16	1500	2.10	28.6	1500	.....	.071	7.1	48	100	370	1830
17	1000	0.74	51.4	1150	.....	.155	6.9	76	58	42	1000
18	1200	1.06	54.7	1160	.....	.109	6.8	78	65	20	1200
19	1250	1.38	76.8	1720	.....	.125	7.3	95	110	300	1400
20	1500	2.32	70.7	1150	.....	.050	7.0	89	140	550	1250
Average	1275	1.71	53.5	1750	246	.097	7.2	75	86	167	1394

A Kink for Pouring Wet Joints*

Here is a trick successfully used by our water crew when pouring a wet joint; that is, if valves are not holding properly and you can't keep water from getting into your joint.

Take one round of braided yarn and grease it thoroughly with cup or water-pump grease. Follow this with one round of *dry* yarn, and pour the joint immediately. The grease coated yarn will hold back the water long enough to enable you to pour a dry joint with either lead or compounds.

*Contributed by Wm. R. Wise, Mgr. & Engr. Public Util., Newberry, S.C.

INCODEL Retains Engineers to Study Delaware River

The Interstate Commission on the Delaware River Basin, commonly known as INCODEL has retained the services of Malcolm Pirnie Engineers of New York City as consultants. Albright and Friel, Consulting Engineers of Philadelphia, Penna., will be associated with the Pirnie organization. These two engineering firms will make necessary engineering investigations to enable the Commission to carry out the reciprocal directive of the 1949 Legislatures of New York, New Jersey, and Pennsylvania. This directive called for a determination of how the waters of the Delaware River and its tributaries may be harnessed in the interests of optimum utilization by the participating states and their political subdivisions for municipal and industrial water supply recreation, flood and salinity control, pollution abatement, navigation, power generation, and related purposes.

METALLURGICAL PLANT WASTES AND THEIR TREATMENT*

Experience at General Motors Plant in Sandusky, Ohio

by

HARRY D. UNWIN

KAHN ASSOCIATED ARCHITECTS AND ENGINEERS, INC.
DETROIT, MICHIGAN

THE trend is definitely toward locating new industrial plants in small communities and on the outskirts of large cities beyond the range of municipal sewage systems. This often necessitates the construction of independent sewage disposal plants into which it is frequently unwise to incorporate facilities for handling the industrial wastes.

More and more plants are being requested to treat their own industrial wastes which were formerly discharged to the sanitary sewers. As a result of the increasing amount of trade waste discharge, it is apparent that suitable collection, treating and disposal facilities must be given equal consideration with the planning of manufacturing operations during the layout and design of new plants as well as when extensive changes to plant layout are made in existing plants, regardless of whether or not economies can be gained by recovery of waste products.

*A paper presented at the Industrial Waste Symposium of the Amer. Inst. of Chem. Engrs. and here published by permission of the Institute.

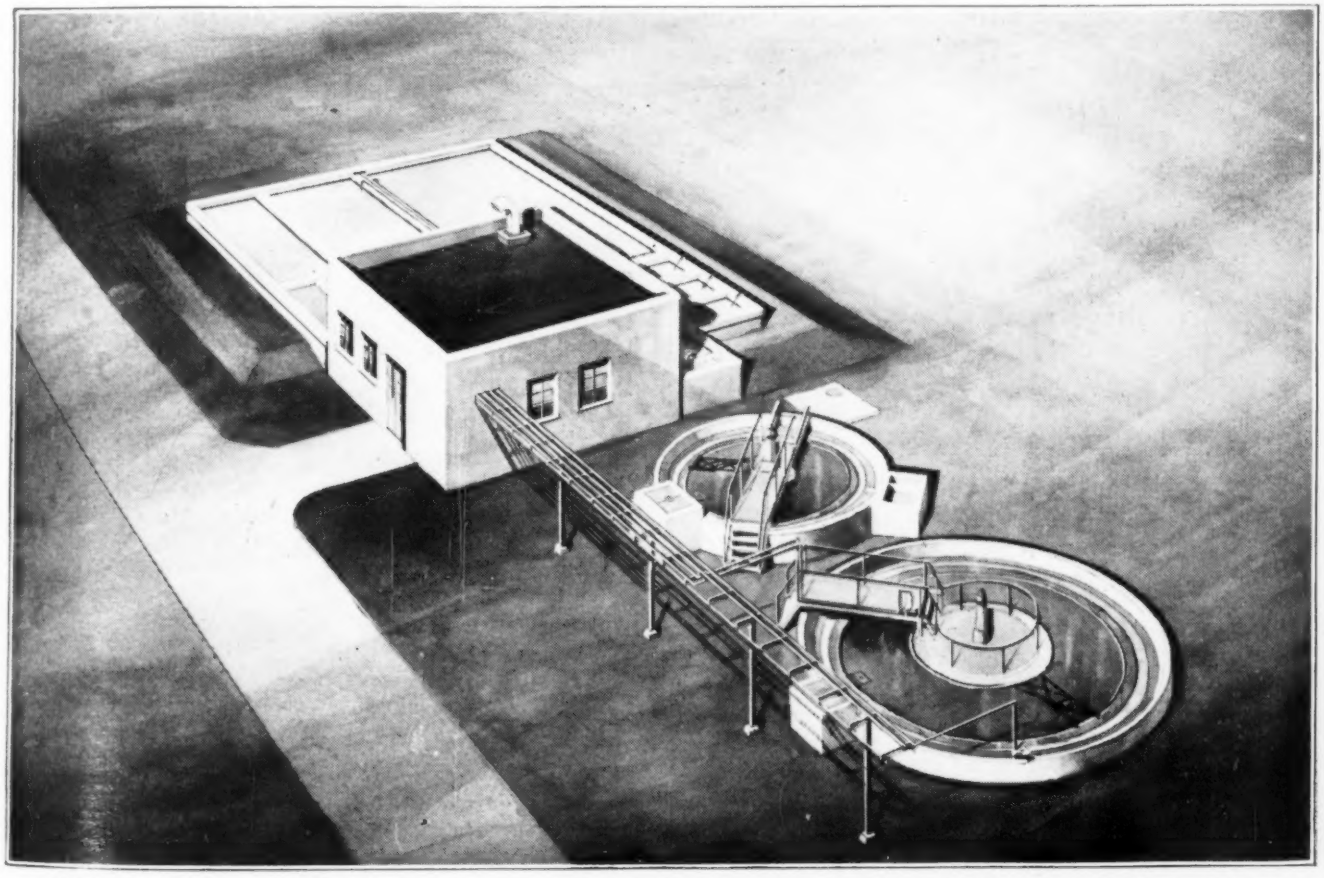
Manufacturing Operations and Distribution of Wastes

Industrial wastes vary in different industries and to a lesser extent within plants of the same industry depending upon the products manufactured and the processes employed. When the New Departure Division of General Motors decided to construct its Western manufacturing plant, a survey was immediately inaugurated to determine the character and analyses of all-process wastes that were anticipated.

To predict what such wastes will be in a plant not yet in operation requires extreme care in estimating probable quantities and concentrations, especially when true comparisons cannot be made in a similar plant.

This plant being the first fully integrated ball-bearing plant ever constructed, it was natural that improvements in layout and manufacturing technic should be introduced that are economically unattainable in older plants which have gradually expanded to their present size.

The manufacturing area of this plant covers approximately 563,000 sq.ft. of floor space under one roof. Industrial wastes originate in the following departments occupying the greater portion of this area: (1) Ball



Architect's Drawing of Industrial Waste Treatment Plant for New Departure Div., General Motors Corp., Sandusky, Ohio

Shop, (2) Press Room, (3) Machining Department, (4) Heat Treating, (5) Grinding, (6) Pickling, (7) Chrome Plating and Parkerizing, (8) Laundry and Dry Cleaning Room, (9) Forge Shop and (10) Miscellaneous. Pickling, chrome plating and Parkerizing are permanently located departments. Nearly all the other operations such as grinding, machining, heat treating, washing, etc., with the exception of forging, are classified as "temporary" inasmuch as future improvements in manufacturing processes and changes in production quotas may require major revisions in plant layout necessitating the relocation of operations responsible for industrial wastes.

The estimated waste data tabulation indicated that the alkali cleaning machines, pickling of steel, chrome plating, Parkerizing, and renewal of coolant make-up tanks are the primary sources of objectionable trade wastes, although the laundry and miscellaneous operations involving the use of insoluble oils such as quench oil, mineral seal oil, hydraulic oil, cutting oils and emulsions contribute to the total waste output of the plant. Of these, the spent pickle liquor, Parkerizing solution, rinse water from chrome plating and the discharge of supersaturated or spoiled coolant are of most importance.

Approach to the Problem

At this stage of such an investigation there are three methods of approach to solving any industrial waste problem:

1. Consider each waste independently and determine the economic possibilities of reclamation so as to eliminate the necessity of disposal. In many metal-working plants, the volumes of individual wastes usually are too small to warrant extensive recovery systems, except in the case of soluble oils used as coolants. Due to the large expenditure involved in equipment and distribution systems for soluble oil recovery and reuse, sufficient savings may not be realized to justify such an investment and amortize it in a reasonable length of time.

Compare this investment with that required to handle and treat the soluble oil for disposal, bearing in mind that there probably will be no salvage value to the waste thus obtained. The proper procedure to follow can be only formulated after such an analysis has been made. Obviously, the answer bears no relationship to the original cost of the soluble oil, but is entirely a question of the economical handling of the material once it has served its purpose and is discharged from the machines.

2. Consider each waste independently of the others and provide means of treating or disposal to eliminate it completely before proceeding to analyze any other of the existing trade wastes. This method may be very uneconomical. Where several trade wastes are present, a careful study of the characteristics and volume may indicate that one or more may be utilized to neutralize effectively or treat another, thus reducing or eliminating the necessity of purchasing chemical treating agents.

3. Completely survey all the trade wastes in the manufacturing plant, carefully analyze the quantity and characteristics of each; and then develop an over-all plan for the treatment or disposal of the various wastes, taking into consideration economy of treatment, flexibility of the collection systems as well as that of the treatment process. This method of approach was followed in the design of the New Departure industrial waste treatment plant because it permitted the realization of the economical benefits to be derived from utilizing the waste pickle liquor to "crack" the emulsified soluble oil present in the alkali wastes.

A consideration of waste reclamation at the New Departure plant was not required since a complete soluble oil filtering and recirculating system was being provided with the production equipment. Treatment of wastes at their source was considered impractical because of the distribution of similar waste producing operations over such an extensive area. Neutralization of waste pickle liquor could be handled at the source but this would entail excessively close supervision and at the same time impose duties on the operators who should be more concerned with production than the control of wastes.

State Requirements

In order to determine the maximum allowable concentrations of various wastes permissible in the storm water discharge from this plant, the State of Ohio Department of Health was consulted and the requirements which they established apply only to the New Departure Western Manufacturing Plant; each problem is considered in respect to the individual plant location and its relationship to the properties through which the storm water discharge will flow.

Mills Creek has practically no flow at certain seasons of the year at the point where the outfall is located; and any increase in its rate of movement is caused by the storm water from this plant which consists of rainwater, effluent from a small sewage disposal plant and process wastes. Furthermore, Mills Creek winds through farm land and passes through a golf course before entering the Sandusky storm sewer system that ultimately empties into Lake Erie. It is evident that toxic wastes, if allowed to enter the stream, would not be sufficiently diluted thereby to become harmless to grazing cattle. Also, the discharge of soluble oils which had been partially reduced by the acid wastes would be completely broken by further dilution; thus this would permit the collection of oil on the surface of the stream in quiescent areas during its winding flow through the golf course. Such oil is not only unsightly but it can become a real hazard, particularly if flammable cleaning agents such as kerosene or other solvents are present.

In view of these conditions, the following maximum concentrations of objectionable substances in the plant storm water discharge were established by the Department of Health:

a. Chromium	2.0 ppm.
b. Emulsified oils	30.0 ppm.
c. Suspended solids	20.0 ppm.
d. pH range	7.0-10.0

The Ohio Statutes specifically require that any new industry, or one making changes and additions to existing establishments, which has industrial wastes must submit plans of treatment and disposal facilities to the State Department of Health for approval prior to construction. This section of the General Code is interpreted to mean that such treatment facilities be installed simultaneously with the construction of a new industrial plant and that they constitute an integral part of industrial process development.

Character of Wastes

Basic information concerning the allocation of the various wastes should be tabulated in such a manner that all the pertinent data necessary to the analysis of the waste disposal problem are indicated. Such a summary should include the nature of the operations creating the wastes; capacity of solution tanks which are dumped and frequency of renewal; maximum daily discharge; nature and concentration of original solutions; the type of contamination, relative concentration and rate of flow of rinse waters.

The soluble oil from grinding and washing machine operations is returned to the central coolant system for filtering and recirculation, but all other wastes must be disposed of in the most practical manner. Three

significant factors were at once apparent—(1) concentration of sulfuric acid and ferrous sulfate present in the rinse from the continuous pickling machine, (2) concentration of chromium from the Parkerizing system and in the rinse from the plating department, although the latter discharges from the second rinse tank, and (3) the relatively large quantity of rinse water from alkali washing machines having a concentration of soluble oil less than 2.0 ppm.

To analyze the data further, it was necessary to break down the wastes into their elementary components, and to classify them in accordance with their composition and source of origin. The industrial wastes were therefore subdivided into four classes: (1) weak alkali, (2) weak acid, (3) coolant central system, and (4) pickle liquor.

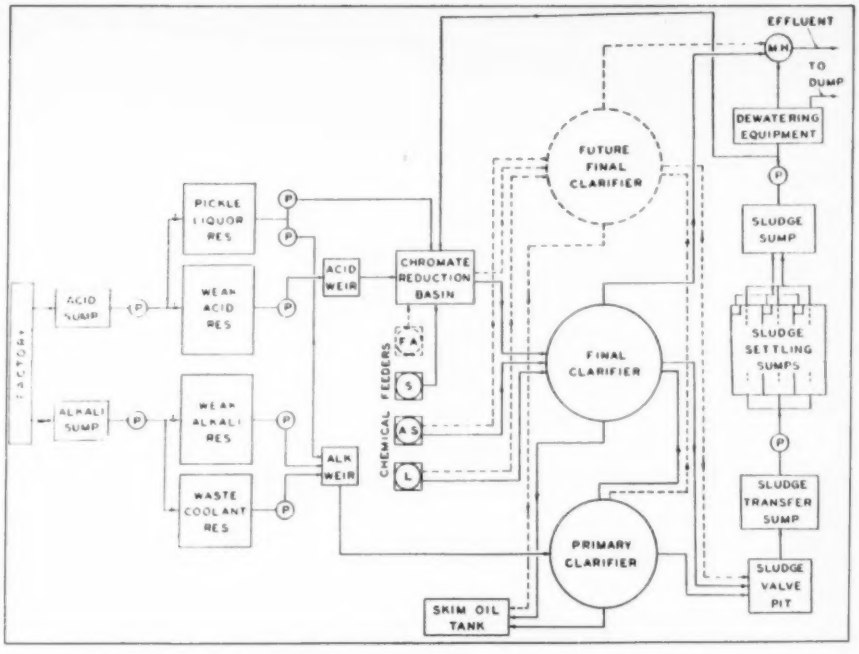
The soluble oil central system has already been mentioned as including the filtering and recirculating system; consequently, this coolant material does not need to be considered, directly, as part of the total wastes which must be handled in the development of an over-all plan for waste disposal. The make-up coolant tanks are seldom dumped but it was considered desirable to provide means for receiving such discharge into the waste handling system for emergency purposes, since accidents have occurred whereby concentrated solutions of soluble oil had to be rapidly removed due to equipment failure or errors in solution preparations.

The weak alkali group of wastes includes all the rinse waters from the washing machines and plating department, lime dip tank discharge, oily wastes from the steam cleaning room, insoluble waste oil from the sump in the oil room where portable containers are emptied, and laundry discharges. Contents of the alkali cleaner tanks of the washing machines, when found too contaminated for satisfactory operation, must be added to this group.

The spent pickle liquor, which has developed too high an iron sulfate concentration for efficient scale removal, is grouped separately in order to study its relationship to the alkali and soluble oil wastes.

The sulfuric acid-bearing rinse waters from the pickling machine, the chromic acid-bearing rinse waters from the plating department, and the Parkerizing solution and rinse waters are grouped together as weak acid wastes for further analysis.

It can be shown that the amount of spent pickle liquor discharged weekly will assist the weak acid waste to neutralize the weekly quantity of soluble oil, lime and alkali cleaning agents which comprise the weak alkali waste division as well as to crack a reasonable amount of soluble oil from the make-up tanks if this should be required. It therefore appeared economical to segregate the pickle acid as a raw material for treating purposes; and separation of the concentrated waste coolant that might be discharged would prevent large quantities of this waste from upsetting the normal character of the weak alkali group of wastes. Since the weak acid waste will also contain chromic acid, this must also be segregated to reduce the quantity to be treated for chromium reduction if this proved necessary.



FLOW DIAGRAM OF TREATMENT SYSTEM

Fig. 1—Flow Diagram of Treatment System

As it is good practice to consider future expansion either in manufacturing facilities or increased operating hours, it was decided to increase the estimated maximum daily discharge of process wastes to 150 percent for design purposes.

The total estimated flow in pounds per day of all wastes on this basis (including the weekly dumping of spent pickle liquor, the semimonthly dumping of the lime rinse tank and the discharge of one 10,000-gal. coolant make-up tank) contains the following contaminating elements:

	150% Design Basis
Sulfuric acid—H_2SO_4	7,600 lb.
Ferrous sulfate—$FeSO_4$	4,300 lb.
Sodium oxide—Na_2O	3,000 lb.
Chromic acid—H_2CrO_4	4.5 lb.
Soluble oil	4,500 lb.
Insoluble oil	1,200 lb.
Water	1,900,000 lb.
Water in gallons	225,000 gal.

Converting these quantities of the estimated wastes to parts per million on the basis of the maximum available water, we have:

Type of Waste	ppm.
Alkali—Na_2O	1500
Sulfuric acid—H_2SO_4	3900
Ferrous sulfate—$FeSO_4$	2200
Chromium	3
Soluble oil	2300
Insoluble oil	650

It should be borne in mind that these concentrations are based upon all sources of trade wastes flowing simultaneously at their maximum estimated rate which results in the greatest quantity of diluting rinse waters. If the dumping of soluble oil make-up tanks is eliminated, concentrations of soluble oil will decrease very decidedly, but all other contaminants will increase. These maximum rates of flow will exist only during periods of peak production; hence, these concentrations can be infinitely greater particularly for a new plant which is building up its production.

If the plating department should be operating without benefit of diluting rinse waters from the pickling machine and alkali washing machines, the estimated waste data indicate a possible chromic acid concentration of 20.9 ppm. in the rinse water from the plating department which would be materially increased if the Parkerizing tank were dumped. By the same reasoning, the rinse water from the pickling system has a concentration of 43.7 ppm., not to mention that the spent pickle liquor, which is discharged weekly, contains 10 percent

sulfuric acid and is highly corrosive to drainage lines not specifically designed therefor. Furthermore, if the soluble oil tanks on the various machines, isolated from the central system, are dumped during a shutdown period, the concentration might be 20,000-30,000 ppm. or higher.

Comparing these possible and probable concentrations of trade wastes with the requirements as set forth by the Department of Health for discharges into Mills Creek, it is evident that these industrial wastes must receive suitable treatment or other methods adopted for their disposal.

Waste Collecting Systems

Wide variations in flow rates and degree of contamination of individual industrial wastes are not conducive to an economical control or treatment system. It is always desirable to obtain a steady rate of flow through a treatment or disposal system and reasonably constant analysis of the wastes. Impounding the wastes in large reservoirs prior to disposal or introduction into the treating system tends to produce more uniform composition within each reservoir as well as permit controlled rates of flow therefrom through the disposal process. Two major waste collecting systems are provided; one for acid wastes and one for alkali wastes. These systems terminate in sumps at the treatment plant from which the wastes are pumped to four receiving reservoirs.

Choice of an overhead collecting system in the factory was predicated on the basis that process operations producing alkali and oily wastes were not permanently located for reasons already discussed. If an underground, gravity-type of collecting system had been provided, considerable cutting of the floor would have been necessary whenever machines were relocated, assuming that no interference with a storm and sanitary sewers as well as electrical ducts would have arisen in the relocation or extension of the waste collecting mains. This clearly indicates the importance of incorporating economical flexibility in the layout of any handling system involving trade wastes.

Both rinse waters and concentrated alkali wastes pass through this system to the receiving reservoirs. When the discharge of the coolant make-up tanks becomes necessary, it will be scheduled at a time when little or no alkali rinse waters are flowing so that this concentrated waste may be impounded separately.

The acid collecting system receives the gravity discharge of spent pickle liquor and acid rinse waters from the sulfuric acid pickling of strip coils and from the chromium plating operation respectively which are considered permanently located departments. Separate underground mains from each of these departments join into a common main extending to the treatment plant. When the iron sulfate content of the pickle liquor has reached its optimum for efficient pickling, it is scheduled for dumping at a time when the sulfuric and chromic acid rinse waters are not flowing so that it may be impounded separately and held in reserve as a useful and low-cost treating agent.

With this arrangement of collecting the various wastes, a minimum of piping is required, maximum flexibility is provided and at the same time the four major types of wastes—weak alkali, weak acid, pickling liquor and spent coolant—are properly segregated and made available for treating and neutralization in any proportion desirable and necessary to dispose of the quantities involved. Storm water and sanitary wastes are handled in independent sewer systems.

Design Basis of Treatment

General methods of disposal were considered, such as:

1. Dilution
2. Discharge to the sewage treatment plant
3. Settling and aeration
4. Evaporation to dryness
5. Chemical treatment.

Disposal by dilution is impractical because of the inadequate amount of rinse water to reduce the chromium and soluble oils below the permissible maximum; and the fact that sufficient additional dilution cannot be expected from Mills Creek into which the industrial wastes must discharge.

Disposal by discharge into the sewage treatment system would be unsatisfactory because the objectionable contaminants in the trade wastes will not settle out; and the oils and chromic acid will seriously interfere with the proper operation of the sewage plant processes.

Disposal by settling and aeration of the combined wastes is uneconomical because of the large volume and character of the wastes.

Disposal by evaporation to dryness requires enormous quantities of heat, the cost of which is prohibitive if supplied by purchased fuel.

Disposal by chemical treatment offers the most practical method of disposal. It affords a high degree of flexibility since flow rates of raw wastes and treating agents can be controlled. It permits wide ranges of concentrations to be handled as well as being adaptable to the treatment of additional trade wastes with little or no change to the mechanical equipment. The chemical treatment plant can be operated continuously or on a batch basis, labor and power costs are at a minimum and the system can be made automatic if desired. For these reasons, this method was selected for the disposal of industrial wastes at Sandusky.

The design of the treating system is based upon handling 150 percent of the estimated peak flow of trade wastes over a 24-hour period; that is 125,000 gal. of weak alkali waste and 85,000 gal. of weak acid waste. In addition, provision is made to impound 8,000 gal. of spent pickling liquor and several thousand gallons of waste coolant. Since pickle liquor is available in quantity from weekly dumping of the pickling tanks, it was chosen as the chemical to be used to break the soluble oil emulsions; consequently, it may be considered as a treating reagent rather than a waste insofar as the treating system is concerned.

In order to reduce the labor cost to a minimum for the operation of the treatment plant, the rate of treatment and neutralization has been established on the basis of handling the ultimate 24-hour peak load in an 8-hour operating period. Therefore, the system as originally laid out has a maximum design capacity of 440 gal./min. which is equivalent to the following daily disposal of wastes:

		gal.
1	Weak acid	85,000
2	Weak alkali	125,000
3	Weak alkali (infrequent)	1,000
4	Waste coolant	1,000
5	Spent pickle liquor	1,000
		213,000

In view of the fact that this ball-bearing plant is entirely new, and all quantities of trade wastes were therefore estimates, good design indicated the desirability of providing means for future expansion of the treatment system without overburdening the initial installation. Since the ultimate design load of 150 percent of the present estimated peak requirements will not be reached for some time, one-half of the final clarification equipment has been omitted. The system, as installed, will handle 75 percent of the estimated peak load in an 8-hour operating period, or 130 gal./min. of alkaline waste and 90 gal./min. of acid waste. The economy of this is seen from the fact that the peak demand can actually increase to 225 percent before additional clarification equip-

ment need be installed, merely by increasing the operating hours of the treatment plant to 24 hours if necessary. However, the reduction in first cost by reducing the capacity of pumps, feeders, etc., did not justify smaller auxiliary equipment.

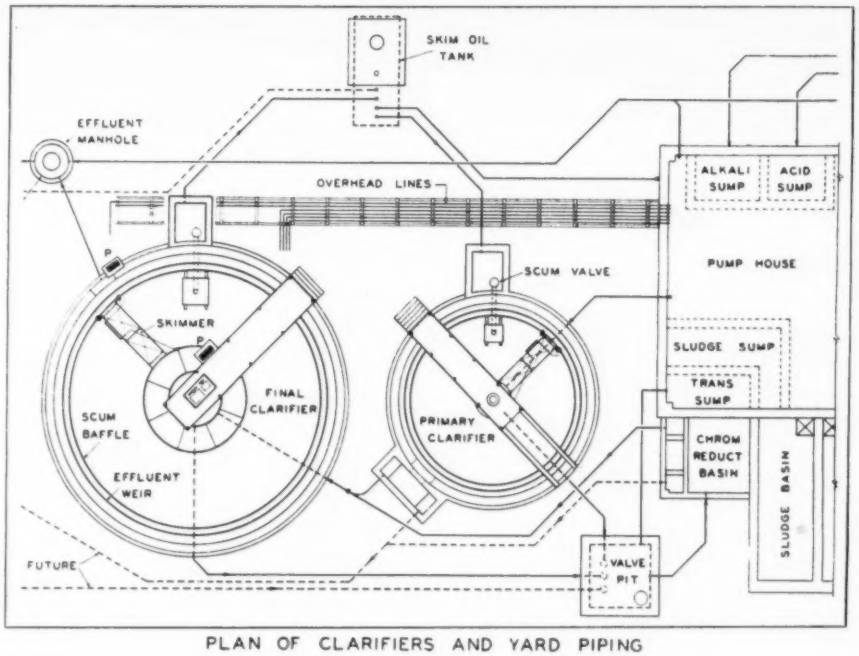
The over-all analysis of the industrial wastes indicated that the system must include neutralization of the acids and alkalies, separation of solids, oil separation and removal and that the mechanical equipment employed could be similar to that used in water and sewage treatment practice.

Treatment Process

The treatment process is accomplished in four stages: (1) primary clarification for partial separation and removal of soluble and insoluble oils, (2)chromate reduction to reduce the chromium in the weak acid waste, (3) final clarification and neutralization, and (4) sludge dewatering and disposal. The flow diagram illustrated in Fig. 1 indicates the equipment involved in this process. The receiving reservoirs, as already mentioned, permit the treatment of wastes therefrom to be a continuous process during the 8-hour daily operating period of the treatment plant. This arrangement has another advantage. When wastes are produced at a much slower rate than normal, they can be impounded in the reservoirs until sufficient have been accumulated to allow a full 8-hour operating of the treatment plant.

Caustic waste from the weak alkali reservoir is pumped through a controlled level weir box to the 20-ft. diameter primary clarifier. To effect acidification and promote oil separation, a portion of the waste pickle liquor is pumped to the weir box where mixing occurs with the alkaline waste. In the primary clarifier, the pH is maintained at about 5.0 to 6.0 for maximum oil separation. The separated oil and some precipitated iron hydroxide separates as a floating scum which is removed by an hydraulic skimmer, and is collected through a gravity line into a below-ground tank. The partially clarified soluble oil-bearing alkali waste discharges by gravity to the final clarifier where treatment is completed and neutralization effected.

The importance of utilizing one waste to treat or balance another waste has been stressed, both of which must be treated before discharge to streams. An example of this occurred when it was found necessary to start the treatment plant due to a large accumulation of alkali wastes containing considerable soluble oil. At that time, no acid wastes had been produced because the continuous pickling machine, chrome plating department and Parkerizing system were not yet in operation. It was necessary to purchase several tons of ferrous sulfate to take the place of the absent spent pickle liquor. Large dosages of this treating agent were required to reduce the pH and break the oil emulsion. The ferrous form instead of the ferric sulfate was used because the former would actually be present and in greater quantity when the spent pickle liquor became available. By using spent pickle liquor, the sulfuric acid will depress the pH and less ferrous sulfate will be required for breaking the oil emulsions.



PLAN OF CLARIFIERS AND YARD PIPING

Fig. 2—Plan of Clarifiers and Yard Piping

When chromium is present in the rinse waters, a preliminary step is required to reduce the chromates from hexavalent to the trivalent form. The weak acid waste containing both sulfuric acid and chromic acid is pumped from the receiving reservoir through a controlled level weir box to the rapid mix or chromate reduction chamber. Any excess of the spent pickle liquor beyond that required for oil separation is also pumped to this basin for disposal. At the same time, the ferrous sulfate content effects partial reduction of the chromium. A more complete reduction of the chromates to trivalent chromium, prior to precipitation, is obtained by feeding a controlled amount of one of the stronger reducing agents such as sodium bisulfite or sodium hydrosulfite.

From the reduction basin, the treated weak acid waste flows by gravity to the 30-ft. final clarifier where lime is added directly to the reaction chamber to effect neutralization and raise the pH to approximately 9.0 for better precipitation of the iron and chromic hydroxides. Activated silica is also added to the agitated reaction chamber to improve coagulation and precipitation of the hydroxides.

The efficiency of final clarification is primarily a function of the rate of separation of the floc. Ferric sulfate, when used as a coagulant, tends to produce more rapid separation than ferrous sulfate, but the latter is available in the spent pickle liquor. The use of the activated silica is to broaden the effective pH range of coagulation and improve the coagulation particularly during winter operation when the wastes are at a lower temperature, and it has the special advantage of increasing the compaction of the sludge formed.

The final clarifier is also equipped with an automatic skimmer to enable any released oil and scum to be removed as a result of reactions not completed in the primary clarifier.

Sludge Handling

The design of the two clarifiers shown in Fig. 2 differ somewhat since the function of the primary unit is oil removal while that of the final clarifier is precipitation and separation of solids. Both the primary and final clarifiers include rotating scraper mechanisms which move the settled sludge to centrally located sumps from which it is periodically discharged through a solenoid controlled diaphragm valve on each clarifier sludge line. These sludge valves are located in a common pit, and are actuated by individual timers for inter-

mittent opening. They are set for the proper frequency and duration of slurry discharge depending upon the rate of sludge formation in each individual clarifier. The combined underflow from the clarifiers flows by gravity to a transfer sump under the basement floor of the pumphouse from which it is pumped to three settling basins (Fig. 3), each having a capacity of approximately 15,000 gal. A minimum retention period of three days is allowed for gravity separation of the solid particles of sludge when the treatment plant is on an 8-hour operating cycle per day.

After settling, as long as operations permit, the clear supernatant liquor is allowed to flow by gravity through an adjustable decanting pipe to the sludge sump from which it is pumped for disposal via the chromate reduction basin overflow to the final clarifier. When the supernatant liquor has been drawn down to the visible sludge line in the settling basins, the basins are refilled with newly discharged slurry. This sequence of operations is continued until the solids have been concentrated three to four times, after which the thickened slurry is ready for disposal.

The original design of the treatment plant provided facilities for dewatering the sludge slurry as it came from the clarifiers. When representative sludge was obtained after running several hundred thousand gallons of alkali and soluble oil wastes through the treatment system, samples were sent to centrifuge and vacuum filter manufacturers whose final recommendations have not yet been received. The present temporary method of disposal consists of pumping the concentrated slurry into trucks and transporting it to a lagoon, or by pumping directly to the lagoon from the settling basins.

The accompanying architect's drawing illustrates the complete industrial waste treatment plant as constructed. The external features outlined in the flow diagram are apparent. They include the receiving reservoirs, pumphouse, chromate reduction basin, primary and final clarifiers, sludge valve pit and sludge settling basins.

Process Control

Collection of the daily trade wastes in the receiving reservoirs produces a more or less uniform character of the basic acid and alkali wastes so that control of the rates of flow through the treatment system is reduced to a minimum. The pressure for reduction in construction costs indicated that automatic controls and other items not essential to the proper operation of the plant should be omitted. Consequently, only indispensable controls were incorporated in the layout. Manual regulation of pump discharges as shown by the rates of flow through the acid and alkali weir boxes, and the frequent laboratory tests for pH and sulfite are adequate to maintain the proper treatment.

For the protection of the system, a pH recorder has been installed to indicate to the operator any large increase or decrease in the acidity in the mixing chamber of the final clarifier. By controlling the treatment at this point, several hours advance notice of irregularities are obtained before unsatisfactory effluent is discharged from the plant. As a further precaution, and to meet the requirements of the State of Ohio authorities, a composite sampler of the type employed in sewage treatment plants has been provided. A continuous sample of effluent from the final clarifier is thus obtained, daily analysis of which provides a permanent record of the average quality of the discharge.

As already mentioned the automatic sludge valves control the rate of sludge discharge from the clarifiers. All sump pumps are float controlled, making their operation automatic.

Operating Data

It is a known fact that ferrous sulfate is an excellent reagent to reduce chromium to the trivalent form when the chromium concentrations are relatively high, but in concentrations below 5 ppm., a stronger reagent must be employed. For this reason, sodium bisulfite has been selected for chromium reduction at the Sandusky plant, since under the estimated normal operating conditions the chromic acid content of the wastes will be less than this minimum.

Operation of the treatment plant started on a partial basis when a maximum volume of alkaline waste containing soluble oil had been accumulated. This was treated with purchased ferrous sulfate as no pickle liquor was yet available. Lime was added to the final clarifier for precipitation of the coagulant and activated silica introduced for better precipitation. The effluent was nearly crystal clear with considerably less turbidity than the permissible maximum. The plant operated periodically on this basis for several months until about 100,000 gal. of weak acid waste had been impounded in the reservoir, the color indicating a very high chromium content, subsequent analysis of which showed the concentration to be 157 ppm.

At the same time, the reservoir capacity for weak alkali waste was attained, and the soluble oil content also far exceeded the anticipated concentration laboratory analysis establishing the amount at 1880 ppm.

It is essential to point out that these seemingly excessive concentrations of chromium and soluble oil which prevailed may be abnormal. Furthermore, if it had been possible to analyze actual trade waste samples instead of estimating probable concentrations, there would have been no greater assurance that manufacturing operations would not change the degree of concentration of various wastes. In recognition of this fact, facilities for a reasonable increase in concentration of the most objectionable substances were incorporated in the design of this plant, but it is not anticipated that an increase of several thousand per cent will occur or persist.

The important fact is that regardless of the cause of the large amount of chromium and soluble oil present, these wastes had to be treated. A small quantity of pickle liquor had been received at the treatment plant, but this was inadequate because of the very low acid content and infinitesimal percentage of ferrous sulfate present. Since ferrous sulfate is an excellent reducing agent for treating waste waters containing relatively high concentrations of chromium, and quantities of this purchased material were available, minor piping changes were made to permit use of the bisulfite feeder for feeding ferrous sulfate to both the primary clarifier for breaking the soluble oil emulsion and to the chromate reduction, or rapid mix basin for chromium reduction.

Reactions which occurred are in general: (1) partial reduction of the chromium in the acid waste and formation of ferric sulfate, (2) high dosage to the primary clarifier released the soluble oil which was skimmed off, (3) primary clarifier effluent contained excess ferrous sulfate and ferrous hydroxide, and (4) combining of the reduction basin discharge and primary clarifier effluent

	Weak Alkali Waste	Weak Acid Waste	Effluent Final Clarifier	Permissible Maximum Requirements
Alkalinity—Na_2O	361	20	32	
Suspended solids	N.D.	N.D.	2.2	20
Soluble oil	1880	N.D.	6	30
Chromium—CrO_3	N.D.	157	1	2
Iron	N.D.	N.D.	1.1	—
pH	9.8	5.9	8.8	10

in the final clarifier resulted in reduction of the chromium below the required limit when sufficient lime was added for precipitation of the metallic hydroxides and neutralization.

Complete samples of the various stages of treatment were not obtainable but laboratory tests with the actual acid and alkali wastes were made with the results expressed in parts per million, as shown in the tabulation on the preceding page.

It was reported that the effluent discharged from the plant agreed with these results which are well below the requirements set forth by the state authorities. It required approximately 30 gr./gal. of ferrous sulfate and 6 gr./gal. of sulfuric acid to break the emulsion containing 1880 ppm. of soluble oil. The acid waste containing 157 ppm. of chromium required approximately 45 gr./gal. to reduce the chromates. For neutralization and precipation of the metallic hydroxides, approximately 30 gr./gal. of lime were required. On this basis, the chemical cost of treating a thousand gallons of alkali and acid waste would be relatively high, assuming no coagulant or acid was available in the spent pickle liquor. The cost of treatment will be considerably reduced by adequate supply of stronger spent pickle liquor containing the usual amount of ferrous sulfate, and further reduction in the treatment cost will accrue if the concentrations of chromium and soluble oil are decreased through careful supervision of manufacturing operations.

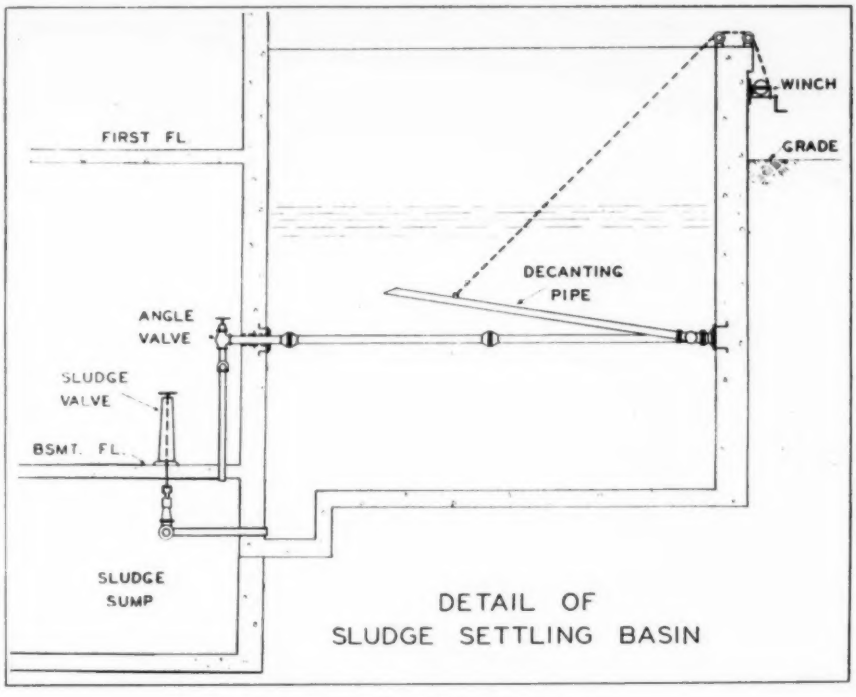


Fig. 3—Detail of Sludge Settling Basin

ANALYSIS OF WASTE

	(1) ppm.	(2) ppm.	(3) ppm.
Alkali Waste			
Alkalinity (Na_2O)	118	75	56
Total oil	1000	110,000	30,000
pH	9.1	9.8	.....
Acid Waste			
Alkalinity (Na_2O)	32	1.2	29
Chromium (CrO_3)	189	9.0	19
pH	6.3	4.8	6.3
Final Effluent			
Suspended solids	11.0	11.6	14.8
Chromium (CrO_3)	2.0	2.0	.....
Total oil	14.0	10.0	8.0
Alkalinity (Na_2O)	127.0	275.0	127.0
Iron (Fe)	5.5	5.8	7.4
pH	11.2	11.6	11.2

Economic flexibility in the layout of any waste treatment plant shall provide means for adapting the facilities to reasonably severe changes in the composition of the wastes. The first few months of operation clearly substantiated the value of such practice as indicated by the accompanying tabulation of waste analyses taken at random.

Later samples show a chromium content in the acid waste of 2-3 ppm. which indicates a reduction to approximately the original estimated concentration; and an oil content in the alkali waste of 1000-1500 ppm. which is more nearly the expected normal concentration although further reduction is desirable.

Treatment of Other Wastes

One of the most important industrial wastes not present at New Departure is cyanide waste from plating, heat treating and other manufacturing processes.

The layout and arrangement of the mechanical facilities of the treatment plant are adequate for handling many wastes not existent at present and in addition, many other wastes can be treated with only slight modification or increase in the facilities.

Conclusions

Conclusions to be drawn from this discussion are so important to the development of a satisfactory industrial waste control system that they are enumerated as follows:

1. Each industry and each plant within an industry are individual units so that the waste control problems must be given special consideration in each case.

2. Every possible method of control should be carefully investigated including dilution or treatment at the source, reclamation, segregation of wastes, and the many possible means of disposal.

3. No one waste should be considered independently. The effect of other wastes and the probability of utilizing them to control or treat each other must be given serious analysis.

4. Local conditions of sewers, streams and other waterways must be ascertained in order to determine the extent of treatment or dilution required.

5. Flexibility of waste collecting systems and methods of control must always be borne in mind as changing production methods and utilization of different process liquid may easily make obsolete the entire waste control system.

6. Perhaps of most importance to the control of industrial wastes is the subject of good housekeeping. Without proper supervision to guard against the discharge of oils and other wastes into sewers and places where they are not intended, the purpose of the entire waste treatment system will be defeated.

FLORIDA HOLDS 17th SHORT COURSE

Also 7th Annual Meeting Fla. S.W.A.

FLORIDA'S 17th Short Course for Sewage and Treatment Plant Operators was held at the University of Florida on June 6-11, inclusive. There were 160 persons registered for the meetings, these registrants coming from 51 cities and 6 states.

According to PERRY M. TEEPLE, Regional Sanitary Engineer, Jacksonville, Fla., and secretary of the Short Course, the operators were given a 40-hour course of instruction, divided equally between conferences on fundamentals and individual work in the new University laboratories. There was one section on Sewage Treatment and three on Water Treatment. These three were divided between elementary, intermediate and advanced sessions.

DR. A. P. BLACK, Head of the Chemistry Dept., University of Florida, and recently elected President of the American Water Works Association, headed the faculty for the Advance Water Treatment Section. Also present at the meeting was V. M. EHLERS, Director of the Sanitary Engineering Division of the Texas State Department of Health, and President of the Federation of Sewage Works Associations. This is the first time that the presidents of both associations have been in attendance at one of the Florida meetings.

Among the special papers presented dealing with water supply were those on ion exchange, water fluoridation, geology in relation to ground water supply, water well construction, disinfection properties of chlorine, and algae in natural water.

On the occasion of the Annual Banquet, awards were presented for the outstanding distinction of the best sewage plant and the best water plant operation of the year. These awards were presented to M. E. DAWKINS, Supt., University of Florida Sewage Treatment Plant, and THOMAS PAUL, Supt., Bradenton Water Plant.

M. E. Dawkins, Gainesville, Fla., and V. M. Ehlers, Austin, Tex.

(Dawkins, Supt. of Univ. of Fla. Sew. Treat. Plant, receives award for best operated plant and is congratulated by V. M. Ehlers, Pres. of Fed. S.W.A.)

FLORIDA SEWAGE WORKS ASSN.

One technical session of the program was devoted to the Florida Sewage Works Association Meeting. At this session there were four technical talks on the following topics: The Sanitary Engineering Research Division of the University of Florida; Operating Experiences of the Daytona Beach Sewage Treatment Plant; Effects of Citrus Wastes on Sewage Treatment; and Facts about the Use of "Transite" Pipe for Sewerage Purposes.

Examinations and ratings of Class B, C, and D Water Works operators' licenses and for Class D & C Sewage Works operators' licenses were held on the closing day of the session.

Officers elected to head the Board of the Sewage Works Association for the year 1949-50 were as follows:

President

S. Keith Keller, Gen. Supt.
Pinellas Co. Water System
Clearwater, Fla.

Vice President

W. J. Parks, Jr.
Cons. Engr.
Jacksonville, Fla.

Secy.-Treas.

Perry M. Teeple, San. Engr.
Fla. Bd. of Health
Jacksonville, Fla.

M. E. Dawkins, Supt. Univ. Treatment Plant, Gainesville, will head the Water and Sewage Works Operators Assn., of which Thomas Paul of Bradenton is Secretary-Treasurer.

Sewage Works Section of Florida Water and Sewage Short School

INDIANA REGIONAL WATER WORKS MEETINGS

Once again the Indiana Section of A.W.W.A. held a series of district meetings. These were held Sept. 13, 14, 15, 20 and 21 at Covington, Vincennes, North Vernon, East Chicago, and Wabash, respectively. Hosts for the individual meetings were James J. Banta, M. H. Schwartz, E. C. Auerswald, A. G. Vinick, and John Ford.

Each meeting featured a morning session on "Records for Efficient Operation." In the afternoon sessions, the topics were demonstrations on talks on tastes and odors and the testing of wells, both old and new. These meetings have become quite popular in the last several years, having been originated during the war when travel to a Section meeting was restricted.

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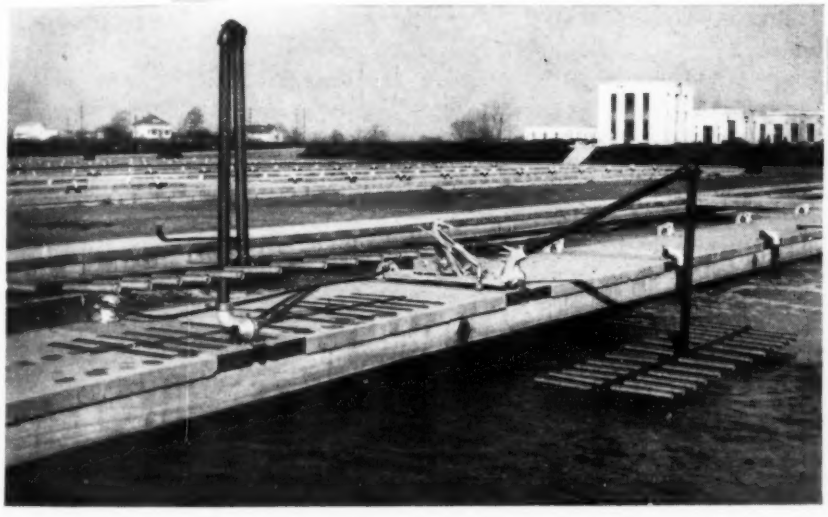

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**Madison, Wis.
Oklahoma City, Okla.—Northside Plant
Nassau County, N. Y.
Bergen County, N. J.
*Chicago Heights, Ill.
Los Angeles, Calif.—Hyperion Plant
*Richmond, Ind.
Boise, Idaho
Boston, Mass.—Nut Island Plant

*Replacement of existing plate system
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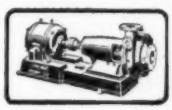

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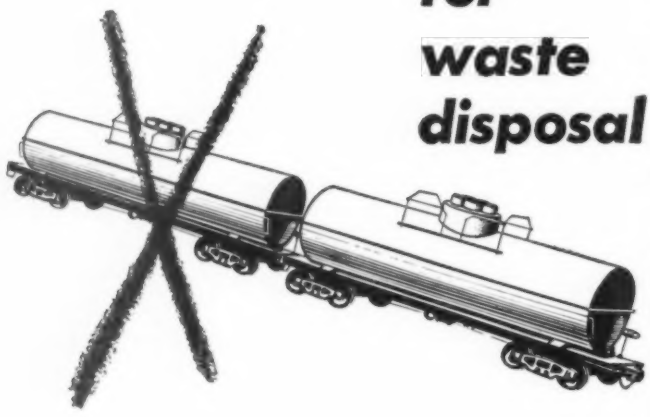

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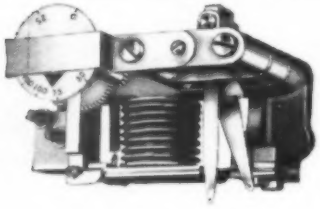
Typical Feature of Foxboro Instruments that simplifies automatic pH Control



Here is the Pneumaticset mechanism that automatically shifts the control point of the Model 40 Controller, within predetermined limits, to assure optimum use of neutralizing chemicals. It operates on pneumatic impulses received from another instrument which continuously measures the ratio of acid to alkali wastes in storage awaiting treatment.

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MEETINGS SCHEDULED

OCT. 3-4—DALLAS, TEXAS (Adolphus Hotel)
National Association of Corrosion Engineers. (South Central Region.) G. R. Olson, Chairman, Box 1407, Shreveport 92, La.

OCT. 5-7—DICKINSON, N.D. (Hotel St. Charles)
North Dakota Water & Sewage Works Conference. Sec'y, Jerome H. Svore, State Dept. of Health, Bismarck, N.D.

OCT. 6-7—BURLINGTON, IOWA (Burlington Hotel)
Iowa Section A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

OCT. 8—LIVINGSTONE, N.J. (Doerr's Grove)
New Jersey Sewage Works Association. 10th Annual Outing. Sec'y-Treas., M. S. Kachorsky, Box 283, Manville, N.J.

OCT. 9-12—OKLAHOMA CITY, OKLA. (Hotel Biltmore)
Southwest Section A.W.W.A. Sec'y, L. A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

OCT. 11-13—MILWAUKEE, WIS. (Hotel Schroeder)
Wisconsin Section A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

OCT. 12—OLD TOWNE, ME.
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Winthrop, Me.

OCT. 17-19—PITTSBURGH, PA. (Hotel Wm. Penn)
Engineers' Society of Western Penna. Sec'y, K. F. Treschow, Wm. Penn Hotel, Pittsburgh, Pa.

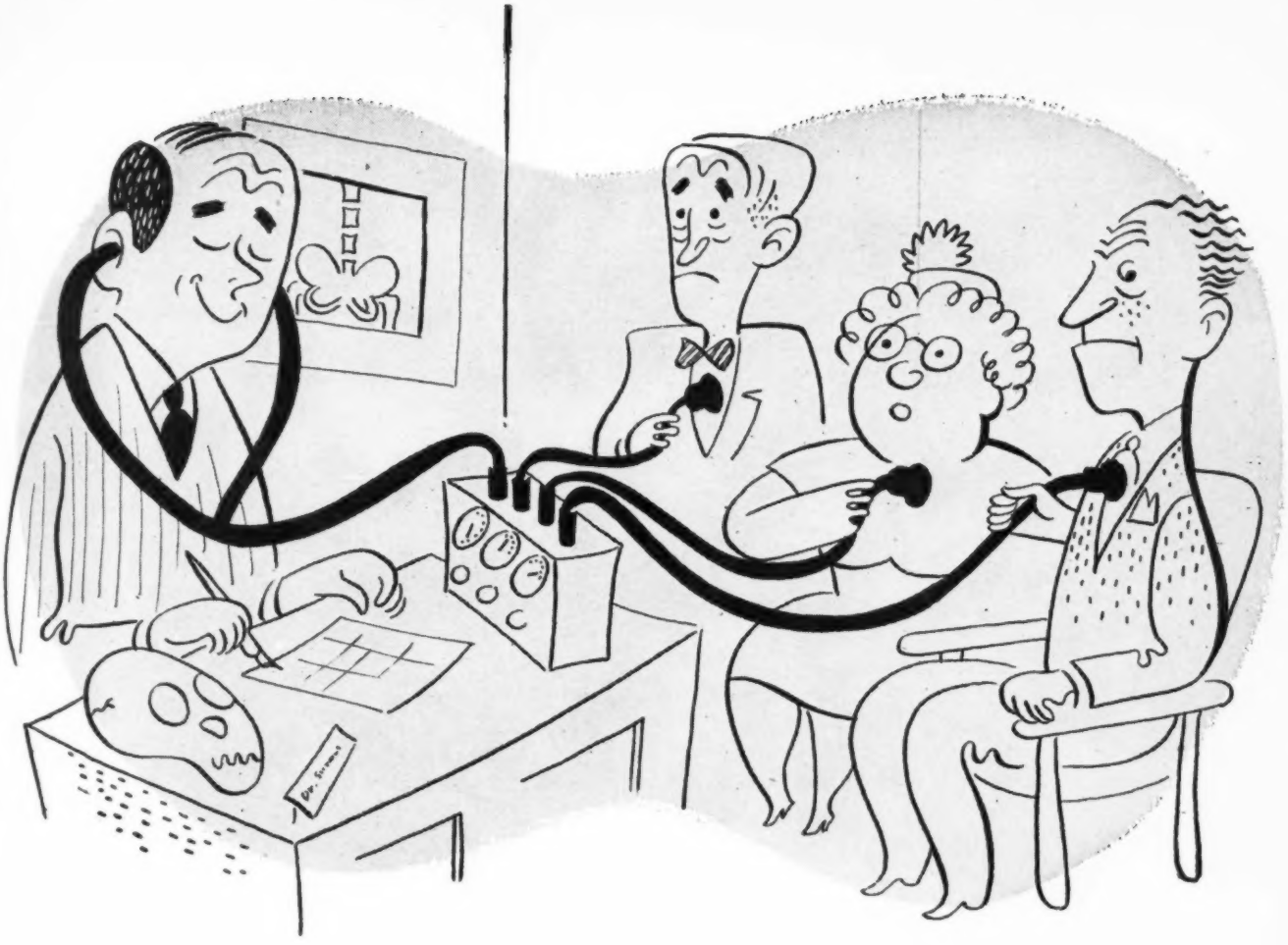
OCT. 17-20—BOSTON, MASS. (Statler Hotel)
Federation of Sewage Works Associations. Executive Secretary, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

OCT. 17-20—BOSTON, MASS. (Statler Hotel)
New England Sewage Works Association. Sec'y, Walter E. Merrill, State Dept. of Health, 511-A State House, Boston, Mass.

OCT. 19-21—JACKSON, MISS. (Heidelberg Hotel)
Alabama-Mississippi Section A.W.W.A. Sec'y-Treas., J. L. Snow, 601 First National Bank Bldg., Montgomery, Ala.

OCT. 24-25—ROANOKE, VA. (Roanoke Hotel)
Virginia Section A.W.W.A. Sec'y, W. H. Shewbridge, 713 State Office Bldg., Richmond 19, Va.

OCT. 24-25—POCONO MANOR, PA. (Pocono Manor Inn)
Pennsylvania Municipal Authorities Association. Sec'y, Charles F. LeeDecker, 103 Sparks Bldg., State College, Pa.



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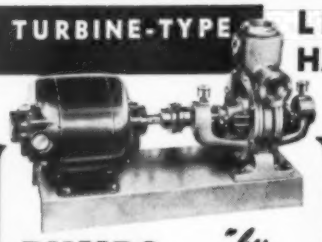

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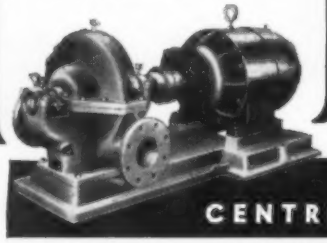

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MEETINGS SCHEDULED

OCT. 24-28—NEW YORK, N. Y. (Hotels Statler & New Yorker)
American Public Health Association. (Annual Meeting) Exec.-Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York, N.Y.

OCT. 25-28—ATLANTIC CITY, N.J. (Hotel Claridge)
Pennsylvania Water Works Association. Sec'y, C. M. Hartman, 279 Boas St., Harrisburg, Pa.

OCT. 26-28—SACRAMENTO, CALIF. (Hotel Senator & Municipal Auditorium)
California Section A.W.W.A. Sec'y, H. C. Medberry, San Francisco Water Department, Millbrae, Calif.

OCT. 31-NOV. 2—LEXINGTON, KY. (Hotel Phoenix)
Kentucky-Tennessee Section A.W.W.A. Sec'y, R. P. Farrell, 420 6th Ave., Nashville, Tenn.

NOV. 2-4—WASHINGTON, D.C. (Wardman Park Hotel)
Chesapeake Section A.W.W.A. (1st Annual Convention) Sec'y-Treas., C. J. Lauter, 5902 Dalecarlia Place, Washington, D.C.

NOV. 3-4—DAYTON, OHIO (Hotel not selected)
Ohio Section A.W.W.A. Sec'y, F. P. Fischer, 812 Perry Payne Bldg., Cleveland 13, Ohio.

NOV. 7-9—SOUTHERN PINES, N.C. (Highland Pines Inn)
North Carolina Section A.W.W.A. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N.C.

NOV. 11-13—YUMA, ARIZ. (San Carlos Hotel)
Arizona Section A.W.W.A. Mrs. Helen Rotthaus, State Department of Health, Phoenix, Ariz.

NOV. 14-16—ORLANDO, FLA. (Orange Court Hotel)
Florida Section A.W.W.A. Sec'y, A. E. Williamson, Jr., P.O. Box 1431, Daytona Beach, Fla.

NOV. 17—BOSTON, MASS. (Hotel Statler)
New England Water Works Assn. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston 8, Mass. (Next meeting Dec. 15th.)

NOV. 17-19—ATLANTIC CITY, N.J. (Hotel Madison)
New Jersey Section A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark, N.J.

NOV. 18-19—GAINESVILLE, FLA. (Hotels Thomas & White House)
Public Health Engineering Conference. Director, Professor John Kiker, Dept. Civil Engineering, University of Florida, Gainesville, Fla.

NOV. 29-30—W. LAFAYETTE, IND. (Purdue University-Union Club)
Fifth Industrial Waste Conference. Chairman, Professor Don E. Bloodgood, Purdue University, W. Lafayette, Ind.

DEC. 5-7—ALBANY, GA. (Gordon Hotel)
Southeastern Section A.W.W.A. Sec'y, T. A. Kolb, Room 433 Wade Hampton Office Bldg., Columbia, S.C.

DEC. 14—AUGUSTA, ME.
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Winthrop, Me.

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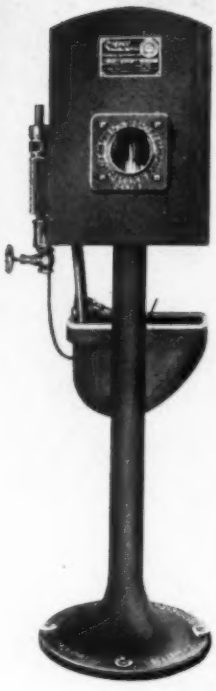

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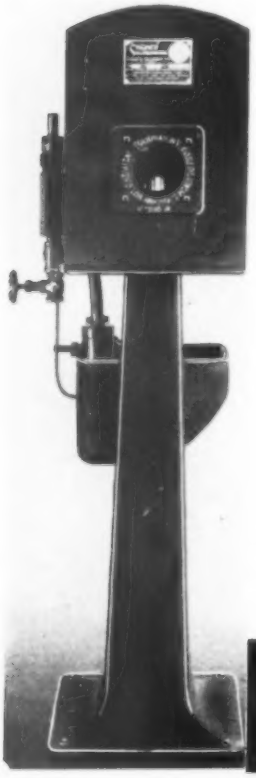

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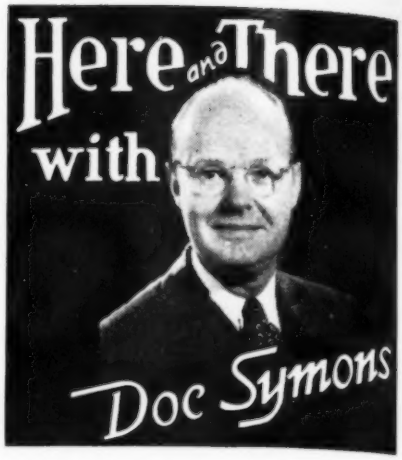

H.T.M.A.—And here it is October —That is, it's October as you read this, but it's mid-July as I write it.— Only way I can get a vacation in is to double-up one month. Inasmuch as this is the tag end of the convention season for 48-49, let's just devote this "letter" to odds and ends. Come next month and we'll get started on the 49-50 season.

* * *

It was at the annual Outing of the Westchester Water Works Conference held in the Town of Greenburgh, N.Y., where I heard an interesting story about Franklin Henshaw, who was the donor of the Henshaw Cup, presented annually to the A.W.W.A. Section with the highest percentage attendance at an annual meeting. Henshaw was the long-time Supt. of Water in Scarsdale, N.Y., a rather wealthy village in Westchester County outside of New York City. According to Henshaw, many of his customers had swimming pools and therefore didn't think much about it when their water bills doubled and tripled in the summer months, but one customer had no pool, and had no explanation of an extremely high bill.

No leaks could be found; the meter registered correctly; there was apparently no explanation. Mr. Henshaw went to visit the customer and in the course of the conversation found that the grandmother had recently come to live with the family. Henshaw asked her how she liked Westchester County. "Fine," she said, "But you know I used to live in Niagara Falls and I get homesick for the sound of the water's roar. I can't sleep without it at night, so I go into the bathroom and turn on all the faucets. Then I can go to sleep."

* * *

From time to time, this column has contained rhymed verses—I won't dignify it by calling it poetry —and I'm always in the market for

more. It was not surprising therefore to receive the following item from L. L. Hedgepeth, Technical Consultant to the American Cyanamid Co., Bound Brook, N.J. No—"Hedge" didn't write it but he obtained it from Dr. D. V. Moses, Tech. Supt., Ammonia Dept., E. I. duPont de Nemours & Co., Belle, W. Va. Dr. Moses read this at one of the meetings of the Industrial Waste Section of the Manuf. Chemists Assn.—It needs no further comment.

The Industrial Waste Man

Joseph Moran was the waste water man
At the Reflux Chemical Mills;
He treated the slops and covered the flops
For the boys who ran the stills.

Now Joe was a guy who, when chosen to die,
Was sent to the heaven abode
Where no Boards of Health, nor Commonwealth
Had framed a pollution code.

Joe climbed up there on the wide golden stair,
With his mind on his earthly trade;
He saw a factory proud on a white fleecy cloud
Where the harps and the wings were made.

He made a quick tour to locate the sewer,
That served this factory high;
But his search was in vain—not a single drain
Discharged in the clear blue sky.

He asked good Saint Pete how he managed to beat
The losses most mortals fear.
And Saint Peter said, "Remember, you're dead;
Things are done differently here."

"Our workers are good, our plant understood;
We have no taxes or rent.
We use a cloud fluff to manufacture our stuff
And our yields are a hundred per cent."

Without any waste, Joe soon lost his taste
For wings and harp playing as well.
With considerable heat he remarked to Saint Pete
That things would be better in Hell.

He was quickly thrown out, through the penalty spout
Which led to the regions below;
Where Satan supreme, amid sulfurous steam
Supervises a most fiery show.

Joe found Nick, the boss, was fighting a loss
Which threatened to ruin his day.
His men, out on strike, had broken the dike
And were draining the brimstone away.

Scowling at Joe, he told him to go
To the aid of the faltering men,
"For if my fire should cease, there'll be an awful increase
In fighting, feuding, and sin."

Joe settled the strike, fixed the break in the dike,
And recovered the sulfur they'd lost.

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R-C Centrifugal Blower, type OIB, in foundry service. Capacity 6,000 CFM, at 21 oz. pressure.
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He sits now with pride, at the Devil's
right side
And counts the profit, not cost.

Joe's permitted to roam, 'round his new
fiery home
And run any tests his heart wishes.
He's now trying his tricks on the foul
River Styx,
Which he soon will have ready for
fishes.

D. V. Moses

* * *

I ran across this picture in my files. It came to me from Walt Kunsch, Supt. of the Urbana-Champaign, Ill., Sanitary District. It was taken at some sort of committee meeting of the Central States Sewage Works Assn. I can recognize Ted (Kenosha, Wisc.) Rudgal, George (Minn. Univ. Prof.) Schroepfer, "Tack" (P.F.T.) Langdon, Kerwin (Minneapolis-St. Paul San. Dist.) Mick, R. S. (Ga. Tech) Nichols, George (Green Bay, Wisc.) Martin, Jos. (Milwaukee City Engr.) Schwada.—But who's the fellow with the pipe, and the other fellow on the right end?

* * *

I see where Don Bloodgood gave our Reference and Data issue a plug in his *Sanitary Engineering News*, which he edits and publishes out at Purdue University. Just to even up this mutual admiration society, I want to say that you ought to be on his mailing list for that monthly sheet of his; you'll find it full of interesting information.

* * *

While I'm on the subject of house organs and such: Did I ever tell you about the house organ that the Ford Meter Box Co. puts out. It's a four-page folder containing cartoons by J. R. Williams; these are the Bull-O-The Woods cartoons. But it is the back page which I find of great interest. On it John Ford tells the story of his family ancestors in short, well done bits. Believe me, if you are interested in the life of our early pioneers in this country, you'll find that the Ford family history is well worth reading.

* * *

Did you know that according to safety engineering studies 16 per cent of accidents resulting from unsafe practices are caused by improper use of ladders? And about ten per cent of these unsafe practices on ladders are over-reaching. Next time you fall off a ladder, remember—I told you.

* * *

Down in Cincinnati, Ohio, last year at the Symposium of Research Grants and Fellowships in the National Institute of Health (U.S.P.H.S.) one of the speakers was Dr. A. M. Buswell, Chief, Illinois State Water Survey. During his talk he

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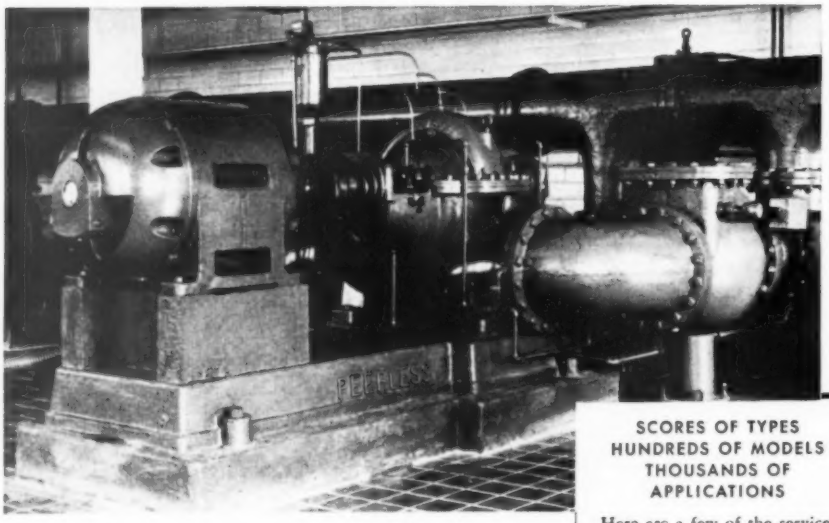

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mentioned that one of his earliest teaching jobs was presenting a course on "Algae" at Columbia University. Sitting the audience was one of his "students": H. S. (Hal) Hutton, Sales Mgr. of W & T.

* * *

And now on this hot July day, I'll bid you adieu for this October day when you'll be reading this—I hope.

V.T.Y.—Doc

THE SPILLWAY

[Overflow from the main section]

Paul Reed Joins U.S.P.H.S. at Chicago

Paul Reed, engineer with the Indiana State Board of Health for the past twelve years, and Chief of the Sewage and Refuse Disposal Sect. for

the past three and a half years, has accepted an appointment as an engineer with the U. S. Public Health Service. Mr. Reed will be located in the Chicago office and will be associated with S. C. Martin, Regional Engineer of the Water Pollution Control Section.

Mr. Reed is secretary of the Central States Sewage Works Assn. and has been editor of *Sewage Gas*, the publication of the Indiana Sewage Works Assn.

Water Pollution Abatement Manual

The Manufacturing Chemists' Assn. has issued a new publication known as Manual Sheet W-2, entitled "Water Pollution Abatement Manual For Insoluble and Undissolved Substances."

This is the Association's second publication on the subject of water pollution abatement, the first (Manual Sheet W-1) dealt with "Organization and Method for Investigating Wastes in Relation to Water Pollu-

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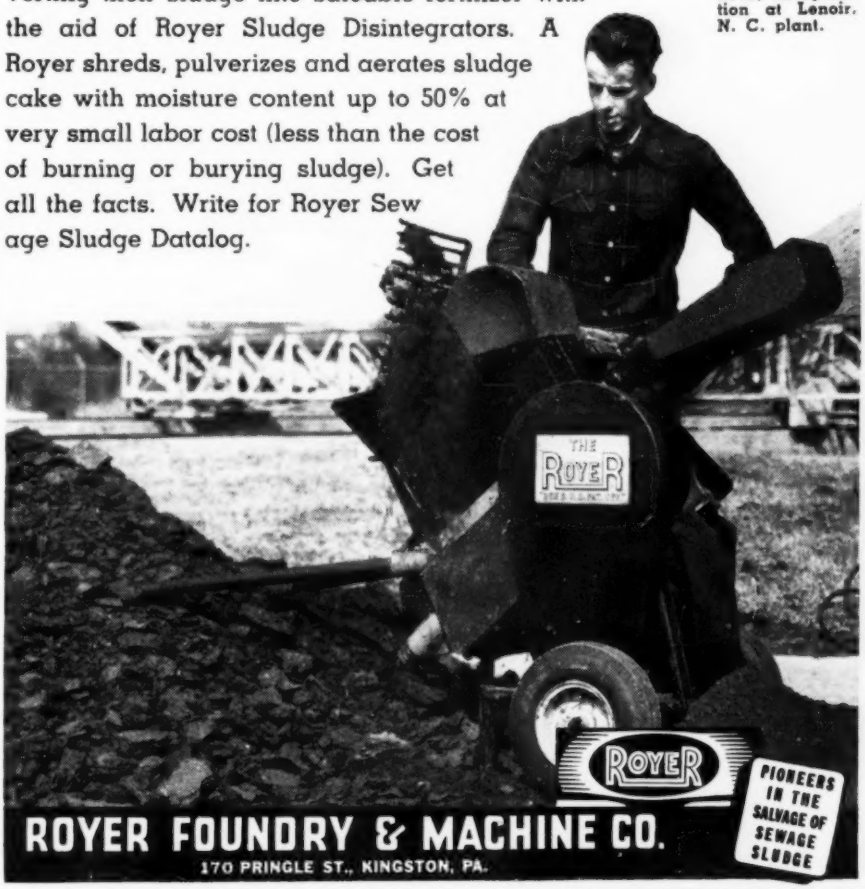

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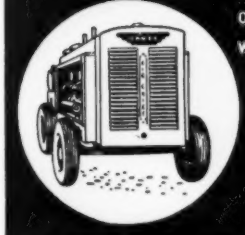

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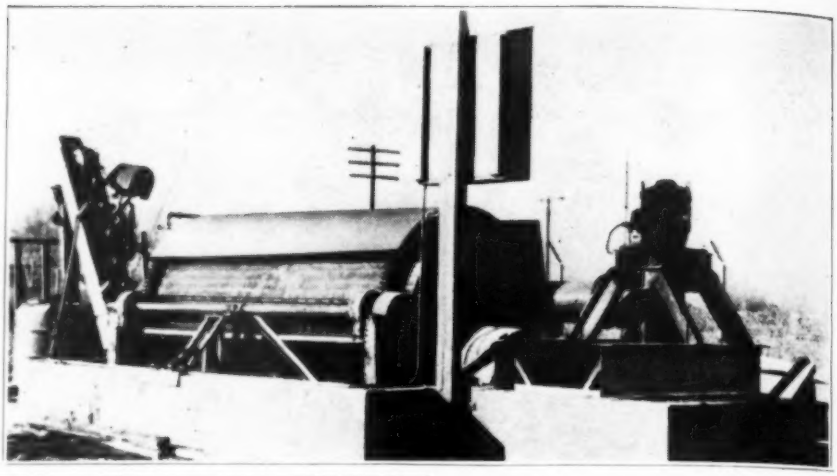
tion." Both Manuals were written by the Association's Water Pollution Abatement Committee.

Manual Sheet W-2 consists of 12 pages and is divided into seven sections, including Effect on Receiving Waters, Permissible Concentrations, Removal of Solids from Waste, Sludge Digestion, Sludge Dewatering, Sludge Disposal, and Equipment Sources.

Copies of the new Manual may be obtained for 20 cents each by addressing a request to the Manufacturing Chemists' Association, Inc., 246 Woodward Building, Washington 5, D.C.



Fruit Cannery Wastes Screened to Reduce Pollution

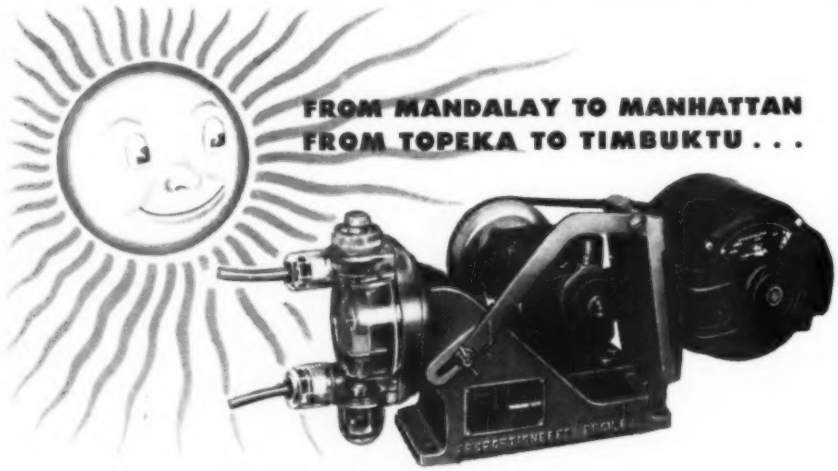
The above photograph shows an installation of a rotary screen for the removal of polluting material at the Kadota Fig Assn., Merced, Calif.

The cannery drains fruit pits, damaged and poor fruit, and other fruit handling waste into a sump. These wastes are picked up by a special purpose single stage low lift, 12-in. Byron Jackson Ditch Pump. The pump discharges through the large fine mesh rotary screen. Water drained from the material goes to settling tanks, the trash is conveyed to a barrel loading station and disposed of. On an average day, the loading station handles five 55 gal. barrels of waste in an 8-hour shift. By this means, odor nuisances are eliminated and pollution load reduced.

Testing and Rating Grease Interceptors

According to an announcement of Elmo G. Liddle, Executive Secretary and Director of Research for the Plumbing and Drainage Institute, there will soon be available for distribution the "Testing and Rating Procedures for Grease Interceptors, Plumbing and Drainage Institute Standard, PDI-G101."

This testing and rating procedure is the result of research beginning in 1933. For the past two years this research has been confined to the laboratories of the United States Testing Co., Hoboken, N.J. The basic testing procedure is designed to simulate an actual plumbing installation. Included with the testing procedure is a table showing the certification, standard flow rates and grease retention capacity ratings for grease interceptors and the recom-



THE SUN NEVER SETS ON

% PROPORTIONEERS % Little Red Pump

%Proportioneers% Heavy Duty Midget Chem-O-Feeder — "The Little Red Pump" — is known and trusted in every corner of the world. To the Chinaman, African, and American alike it means safe, pure water. It handles the all-important jobs of water sterilization, taste and odor control, water softening, and dozens of other water treating applications. Because of its extremely simple, rugged construction, the Little Red Pump can be safely operated by almost anyone. It treats from a few gallons to a million gallons of water a day and feeds chemicals up to 7½ g.p.h. against pressures to 85 p.s.i. The chemical being fed shows plainly in the "See-Thru" plastic head and the action of the valves and diaphragm is clearly visible. Over 27,000 %Proportioneers% units right now are making this a healthier, better world to live in.

Write for Bulletin HDM-2

FEEDS . . .
Hypochlorite Solution
Hexametaphosphate
Alum Solution
Ferric Chloride
Soda Ash
Sodium Fluoride
and other water treating chemicals

% PROPORTIONEERS, INC. %
PROVIDENCE 1, R. I.

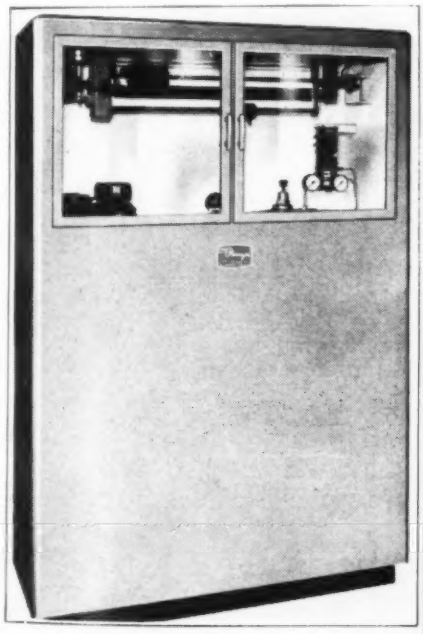
mended maximum capacity of fixtures to be connected to interceptors of various sizes.

Requests for "Testing and Rating Procedure PDI-G101" should be addressed to the Executive Offices of the Plumbing and Drainage Institute, 18925 Grand River Ave., Detroit 23, Mich.

MANUFACTURERS' and EQUIPMENT NEWS

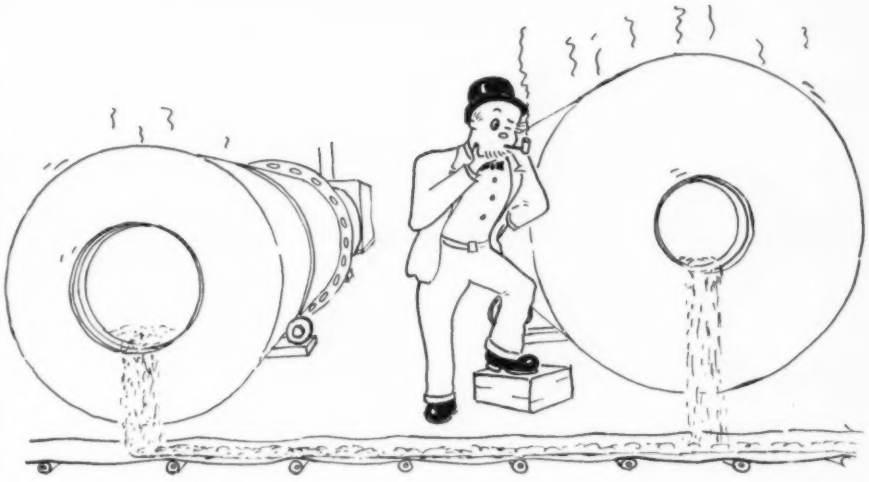
1000
Gravimetric Chlorine Gas Feeder

Builders-Providence, Inc., Providence 1, R.I., has announced the supplementation of their line of volumetric chlorinizers, with a gravimetric chlorinizer, Model CGS. This unit establishes new standards of accuracy in feeding chlorine gas to produce chlorine water solutions.



The new unit meters and feeds gaseous chlorine by a loss-in-weight principle. It is particularly suited to high capacities, but is also well adapted to exact low rate feeding. The chlorine control cabinet and chlorine weight scale are separate

Sludge Drying Troubles?



"I'm not much on figgers—but we had these two rot'ry sludge dryers in the plant, a RUGGLES-COLES and another, and it just seemed like we wusn't gittin' the work out o' the one of thim.

"I told the big boss about it, an' he sent one o' his ingineers over to run tests. Well, you shoulda seen the look on this guy's face whin 'is figgers showed that we was burnin' a lot less coal per ton o' dry product in the RUGGLES-COLES.

"Thim ingineers are on my side now. Whinever we add a new dryer to the setup, they specify RUGGLES-COLES."

See our exhibit in Booth No. 4 at the F.S.W.A. Show, Hotel Statler, Boston, October 17-20. For information on sludge dryers, write for Bulletin 16-D-15.

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COMPANY INCORPORATED
YORK, PENNSYLVANIA—240 Arch St. • Main Office and Works
NEW YORK 17—122 E. 42nd St. • 205 W. Wacker Drive—CHICAGO 6
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ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. COREXITE mineral for corrosion control and water stabilization.

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Sales Office 140 Cedar St., New York, N. Y.
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Pioneer Producer of GREENSAND ZEOLITE MINERAL

Phipps & Bird
LABORATORY MIXER

IS the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosages with this mixer. Write for literature.

PHIPPS & BIRD, INC. Richmond, Va.

units, inter-connected only by small air piping. No chlorine is present at the control station.

For further information on this new unit, use a Reader Service Card on which is entered the above key number and your name and address.

1001

Rust Prevention

Speco, Inc., 7308 Associate Ave., Cleveland 9, Ohio, has announced new applications for the protective coating known as "Rustrem." The material can be applied right over rust without wire brushing or scraping. It penetrates and seals the surface, effectively preventing further rust action. It is available in black or aluminum, and resists temperature changes, moisture, industrial chemicals and gases, and is ideal for underwater use.

To obtain further information on this material, use a Reader Service Card on which is entered the above key number and your name and address.

R. C. Clement Honored by W & T

R. C. (Smoke) Clement was honored in August by Wallace & Tiernan Co. on the occasion of his 25th anniversary with the company. About sixty executives and fellow workers joined in the presentation of

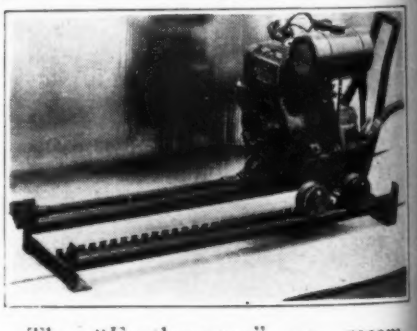
a sterling silver tray, a desk lamp and other tokens of appreciation. W. J. Orchard, General Manager of the company, presented Clement with a 25-year diamond service pin.

Mr. Clement is Eastern Divisions manager for Wallace and Tiernan, and is located in the home office in Newark. Prior to his present position which he has held for several years he was in charge of the Washington, D.C., office. He began work with the company in the Pittsburgh office.

1002

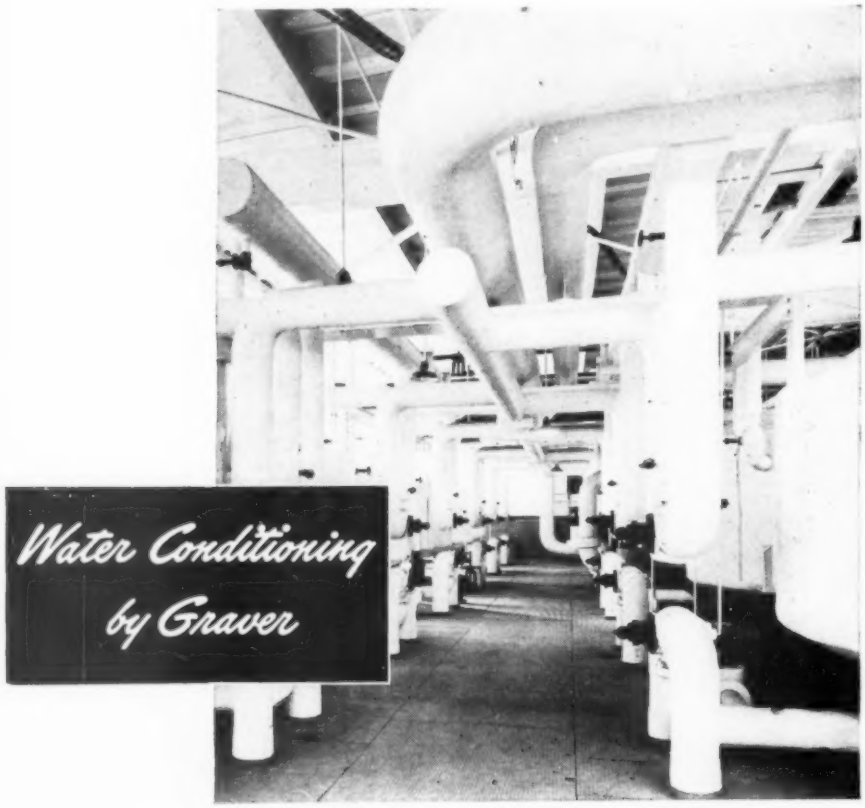
Boring Machine

The Lube Jack Co., 1415-14th St., Santa Monica, Calif., has announced a new improved line of "Earthworm" boring machines. These new machines will permit the laying of pipe lines of all types up to 3 inches in diameter and up to 150 feet in length, without the need of breaking surface ground for such operations.



The "Earthworms" are recommended for laying lines under highways, parking lots or other sites where excavation would be costly and inconvenient. Accuracy to within one inch at 150 feet is claimed. In operation, water is forced through the drill stem as a lubricant and to wash back the cuttings. Three types of bits are available.

(*Continued on page* 107A)



**PRESSURE WATER FILTERS—
A PART OF THE COMPLETE GRAVER LINE**

Water filters may be the solution to your water conditioning problem. If they are, Graver engineers will recommend their installation. But, if another type or a combination of equipment will meet your requirements, more efficiently, more economically, then Graver engineers will recommend that type.

The Graver line is complete. It includes all types of water conditioning equipment . . . reactivators, hot process softeners, zeolite softeners, demineralizers, deaerators, condensate conditioners, plus the various combinations of these types that specific conditioning problems demand.

Avoid the danger of installing the wrong equipment. Call in a Graver engineer today. Get a sound, impartial recommendation. *There's no obligation.*

GRAVER

GRAVER WATER CONDITIONING CO.
216 West 14th Street, New York 11, New York, U.S.A.
CHICAGO • PHILADELPHIA • CLEVELAND
A DIVISION OF GRAVER TANK & MFG. CO., INC. EAST CHICAGO, IND.

REA
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WATER & SEWAGE WORKS READER SERVICE

READER SERVICE CARDS HOW TO USE THEM

Please fill out a separate coupon for each item on which you desire information. This will greatly facilitate handling.

Key number is at head of each new product, item of equipment, catalog or bulletin, described in this issue.

Enter key number in box.

Please PRINT your name and title, company or department name, and your address

NOTE—

These cards are to be used only for items described in THIS ISSUE

WATER & SEWAGE WORKS

Will see that you receive information desired.

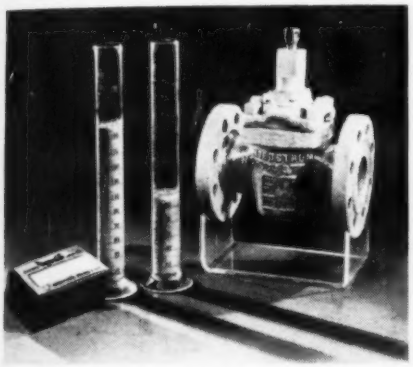
(*Continued from page* 106A)

For further information on this unit, use a Reader Service Card on which is entered the above key number and your name and address.

1003

Automatic Plug Valve Lubrication

Nordstrom Valve Corp., a Division of Rockwell Manufacturing Co., Pittsburgh, Penna., has announced a revolutionary development in the lubrication of plug valves. This new lubricant, known as "Hypermatic," does not involve the use of any additional equipment to existing plug valves. It is simply automatic lubrication without mechanical device. The lubricant itself stores the energy to maintain pressurized lubrication of the valve. The accompanying photograph shows the difference between the new lubricant and old type lubricants as to the amount stored in the valve. The "Hypermatic" valve lubricant is represented by the cylinder on the left.

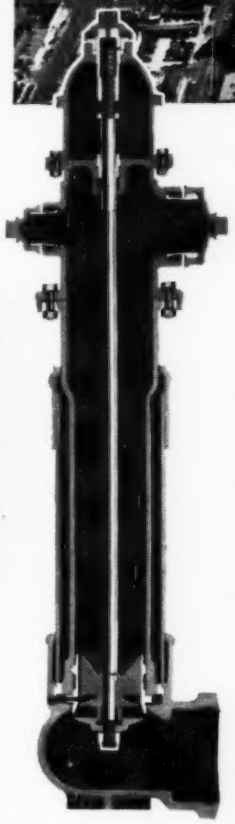


The new lubricant was compounded and developed by George F. Scherer, director of research, Nordstrom Valve Division, who worked on the problem for more than twenty years to eliminate one of the objections to lubricated valves: the necessity for frequent re-lubrication.

"Hypermatic" is self-sealing, and is actually compressed, thus creating an "energized" condition which will automatically feed the lubricant to seal the seating surfaces and fill voids in event of a leak.

The advantage of this lubricant is that it can be used in any of the more than 5,000,000 valves of the Nordstrom type. It will save maintenance costs, protect equipment and assure proper functioning of valves at all times. This type of plug valve has found wide acceptance in sewage plants and in many water plants.

To obtain further information about this new lubricant, use a Reader Service Card, on which is entered the above key number and your name and address.



TAMPA, FLORIDA

"One of America's Safest Cities"

THE MATHEWS FIREMEN SAY

They back up their statement by pointing to the Mathews Modernized Hydrants used by this great seaport. Wherever you see Mathews, you know there is safety *plus*.

Mathews Modernized Hydrants are the last word in simplicity of design. All working parts are contained in a removable barrel. The bronze revolving nut is capped by an iron shield operating nut which is resistant to wrench wear. The operating thread is not exposed to water—is protected from sand and grit. The stuffing box plate, cast integral with the nozzle section, is strong, safe and leakproof. The simple, rugged construction of the Mathews offers the utmost dependability and the least in maintenance requirements.

When broken in a traffic accident, a Mathews need be out of service only so long as it takes to replace the barrel with a spare—a matter of minutes. And a damaged Mathews means no loss of water, because the main valve opens *against* the pressure.

Send for our illustrated booklet and see how Mathews Modernized Hydrants can contribute to the safety of your community.

OTHER MATHEWS FEATURES: Head can be turned 360° • Replaceable head, nozzle outlets easily changed • Nozzle levels easily raised or lowered without excavating • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • Operating thread only part to be oiled • A modern barrel makes any Mathews Hydrant good as new

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (Centrifugally Cast in Sand Molds)

DARLEY MAGNETIC DIPPING NEEDLE $17.50

with 3 section telescoping handle $22.25

Write Today for 68-Page Catalog

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A Filter Medium For All Purposes

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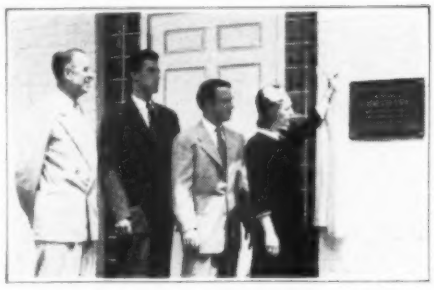
Engineers and Sales Agents

Atlas Mineral Products Dedicates Laboratory To Founder

The Atlas Research Laboratories of the Atlas Mineral Products Co., was dedicated at Mertztown, Pa., on August 20 as a memorial to the late Maximillian F. Wirtz, who founded the firm in 1892.

The ceremony was featured by the unveiling of a plaque in memory of the founder by his widow, Bernardine Wirtz Dorr. George L. Wirtz, President and son of the founder, paid tribute to his father's vision in an address titled "The Employee's Stake in Research."



The Atlas Laboratories, which are housed in a two story brick building, contain more than 5,000 square feet of floor space, and are staffed by twelve chemists and technicians under the direction of Dr. Raymond B. Seymour, Technical Director, and Joseph Dahle, Research Director.

1004

Sewer Joint

Universal Sewer Pipe Corp., Cleveland, Ohio, has developed a new "Tylox" rubber coupling joint for vitrified clay pipe and industrial effluent lines. "Tylox" couplings are pre-assembled, and have long life and great resistance to acids, alkalis

and waste material action. The coupling joints are self-locking and leak proof for the life of the line but they permit leveling and bedding of the line to grade.

To obtain further information on this "Tylox" rubber joint, use a Reader Service Card on which is entered the above key number and your name and address.

N. W. Snyder Joins Santa Fe Tank as Consultant

Announcement has been made of the appointment of Dr. N. W. Snyder, of the Dept. of Mechanical Engineering, Univ. of California, as Chief Technical Consultant for the Santa Fe Tank and Tower Co. Dr. Snyder will undertake the direction of extensive plans for cooling tower research and development.

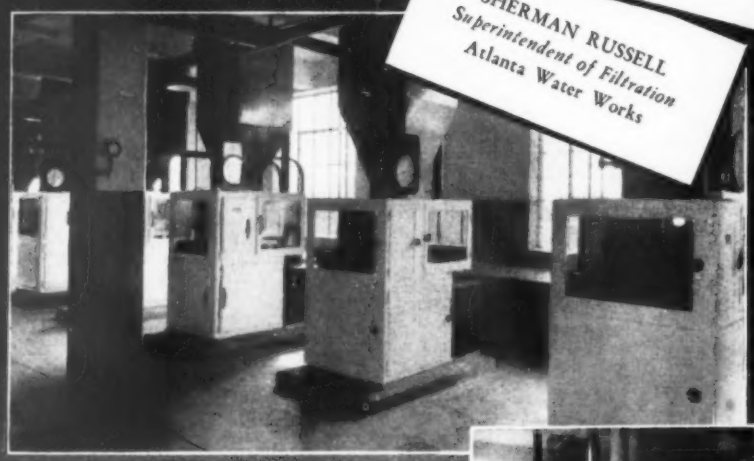
ATLANTA, GA.

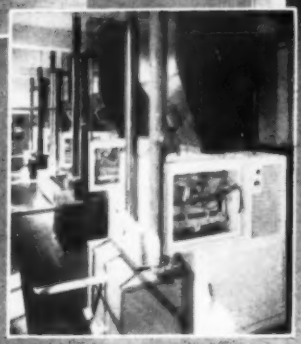
Atlanta Water Works

(Completed in 1946)

PAUL WEIR, *General Manager*
Atlanta Water Works

SHERMAN RUSSELL
Superintendent of Filtration
Atlanta Water Works





Under the direction of Paul Weir, Genl. Mgr., and Sherman Russell, Supt. of Filtration, an up-to-date taste and odor control program initiated ten years ago at Atlanta Water Works has been brought to successful completion. This water works now supplies almost 72 MGD of pure, palatable water to the metropolitan Atlanta area. Clay, carbon, alum, and lime are fed by Omega Gravimetric Feeders to water supplying three filtering units: one 18 MGD pressure filter plant and two gravity type rapid-sand filter plants of 21 and 33 MGD capacities, respectively. For Bulletins describing Omega equipment, address Omega Machine Company, (Division of Builders Iron Foundry), Providence 1, R. I.

Omega equipment furnished Atlanta Water Works:

8 Belt-type Gravimetric Feeders with Rate of Feed Recorders, Mixing Chambers, Storage Hoppers, and Dust Collectors.

1 six-unit Laboratory Stirrer.

THE EASY WORD IN FEEDERS
OMEGA

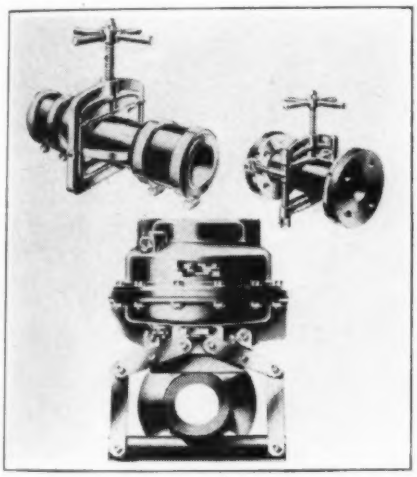
D. D. Ackerman Joins Ludlow Valve

Ludlow Valve Manufacturing Co., Inc., has announced the appointment of David D. Ackerman as Sales Engineer for the company. Mr. Ackerman will be located in the New York Office at 11 West 42nd Street. He was formerly in business for himself as head of the Seaboard Well and Pump Co., of Closter, N.J.

1005

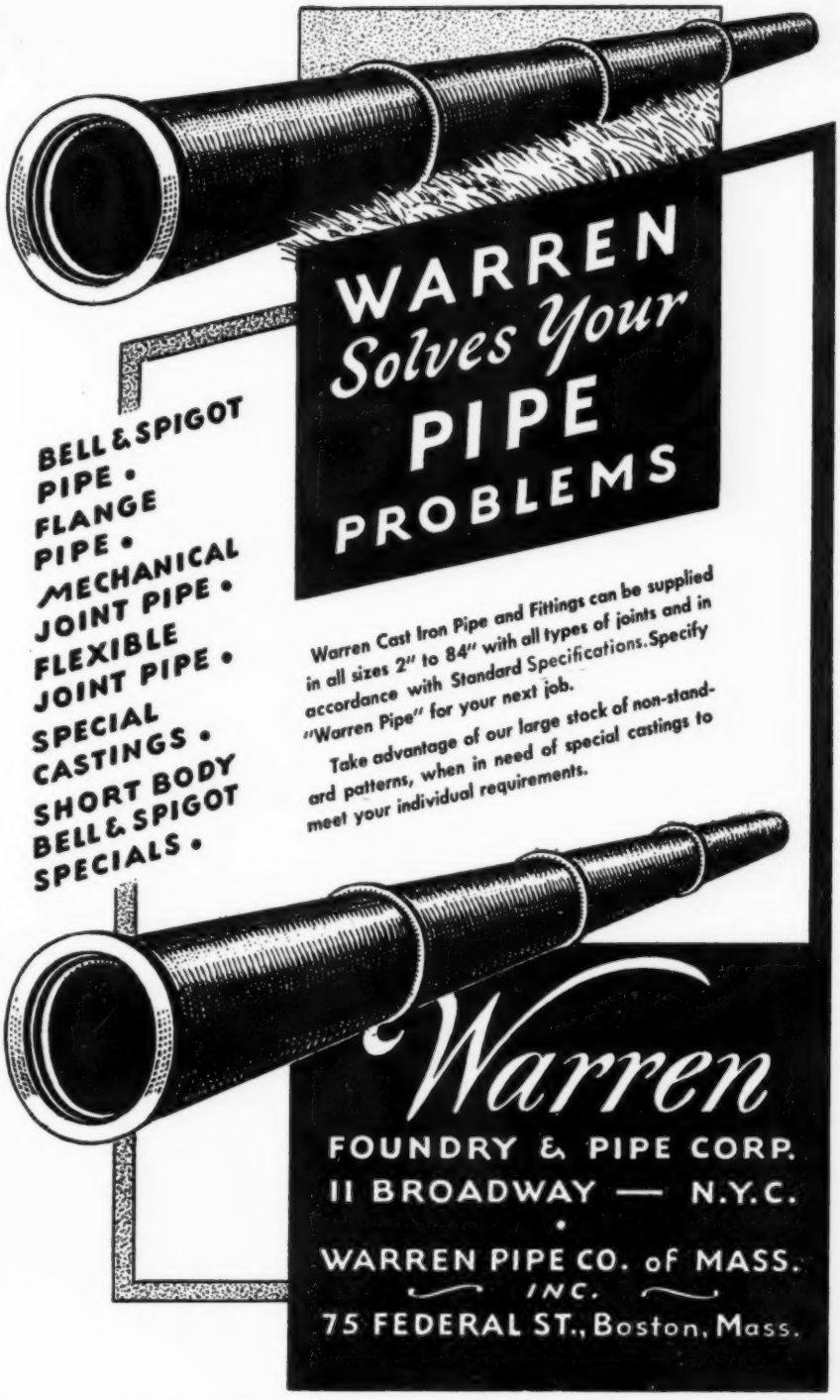
Flex-Valves

The Flexible Valve Corp., Palisades Park, N.J., has released three new lines of their "Flex-Valves." These lines consist of the "Slip-On"



Type in sizes ranging from ½ inch to 12 inches. The valve offers such features as no internal parts or obstructions, freedom from water hammer, long life under abrasive conditions, non-clogging service, full pipe capacity, and bubble tightness. The Diaphragm Type may be used for Remote or Instrument Control. The valves have met with the acceptance in paper pulp, coal, sand, chemical, sewage treatment and other industries.

For further information on this "Flex-Valve," use a Reader Service Card on which is entered the above key number and your name and address.


WARREN
Solves Your
PIPE
PROBLEMS
BELL & SPIGOT PIPE • FLANGE PIPE • MECHANICAL JOINT PIPE • FLEXIBLE JOINT PIPE • SPECIAL CASTINGS • SHORT BODY BELL & SPIGOT SPECIALS •
Warren Cast Iron Pipe and Fittings can be supplied in all sizes 2" to 84" with all types of joints and in accordance with Standard Specifications. Specify "Warren Pipe" for your next job.
Take advantage of our large stock of non-standard patterns, when in need of special castings to meet your individual requirements.
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LaMOTTE
Water Soluble pH Indicators

(Sulfon-phthalein Series) pH 0.2-9.6

Originally developed in the LaMotte Laboratories.

Are of the same superior quality as the acid form hitherto available for pH work. Instantly soluble in distilled water. No alkali required — No heating necessary.

LaMOTTE CHEMICAL PRODUCTS CO.

Dept. WSW Towson, Baltimore 4, Md.

BOND-O

A safe self-caulking, self-sealing compound for jointing water mains. Used with complete confidence. Machine-blended for absolute uniformity. All BOND-O contains a germicide to inhibit oxidation by sulfur bacteria.

Northrop

Northrop & Company, Inc.
SPRING VALLEY, N. Y.

Every Bond-o Joint is a Good Joint

M. A. Clift To Become Manufacturers' Agent

Mortimer A. Clift, formerly Manager of the Sanitary Engineering Department of Nichols Engineering and Research Corp., has resigned from that company and opened an office as a manufacturers' agent. He will be a sales representative for Nichols Engineering & Research Corp., New York, Simplex Valve & Meter Co., Philadelphia, The Eimco Corp., Salt Lake City, The Ralph B. Carter Company, Hackensack, N.J., Hydro-Ash Corp., Chicago, and Shallcross Controls Inc., Milwaukee.

Mr. Clift's office will be located at 815 Berkley Road, Indianapolis 8, Ind., and he will cover the states of Ohio, Indiana, Kentucky and Tennessee.

FERRIC CHLORIDE SOLUTION

LOOK TO DOW AS YOUR SOURCE OF SUPPLY

A SUPERIOR COAGULANT FOR:
- SLUDGE CONDITIONING
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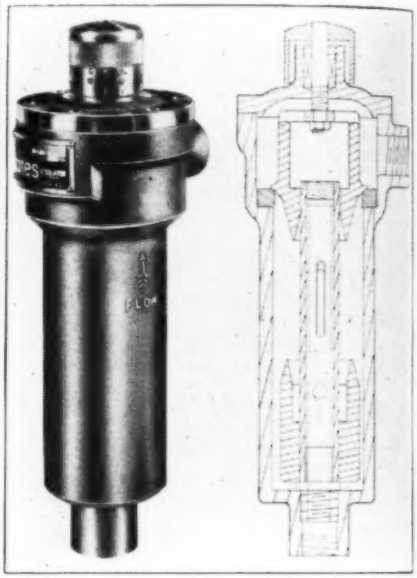
DOW
CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

1006

Regulator For Constant Volume Control

The W. A. Kates Co., Deerfield, Ill., has developed a new regulator control to produce constant volume flow under varying pressure. This is accomplished by the Kates Regulator which uses no pressure pipes, diaphragm, or motor operated external valve, springs, or levers and has only a single moving part. The regulator will hold any pre-set flow volume constant, while the pressure upstream may vary over a 100 psi. range.



The regulator is self-contained and requires no air or electrical power to operate. It is applicable to backwash and rinse control in water treatment installations, and to a wide range of chemical plant problems.

For further information about this new unit, use a Reader Service Card on which is entered the above key number and your name and address.

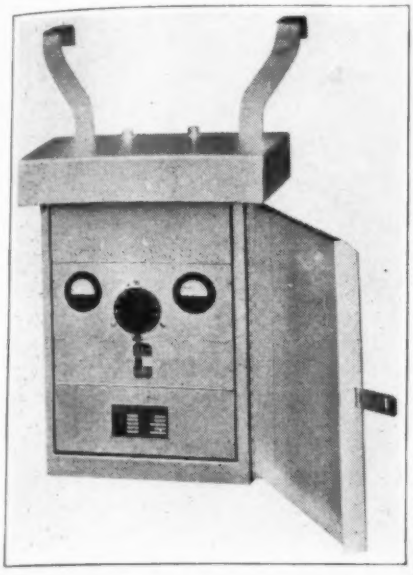
Aluminum Co. To Produce Fluoride Chemicals

Aluminum Ore Co., a wholly-owned subsidiary of Aluminum Co. of America, has completed an ultra-modern plant for producing fluoride chemicals. The plant is located at East St. Louis, and will operate on products taken from the deposits of fluorspar at nearby Rosiclare, Ill. The principal products of the new plant are sodium fluoride, sodium bifluoride and high strength hydrofluoric acid.

1007

Cathodic Protection

The Industrial Electronics & Transformer Co., 1801 E. Slauson Ave., Los Angeles 11, Calif., has designed a new Selenium rectifier cathodic protection unit for cathodic protection of pipes and tanks.



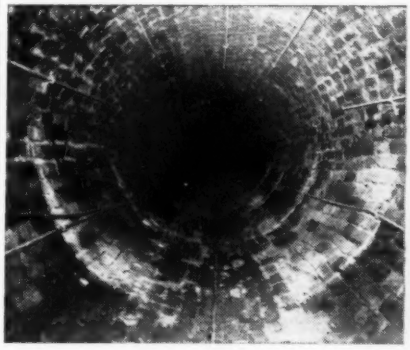
The unit embodies many original features and special emphasis has been placed on high temperature operation. Complete ranges of standard units are available.

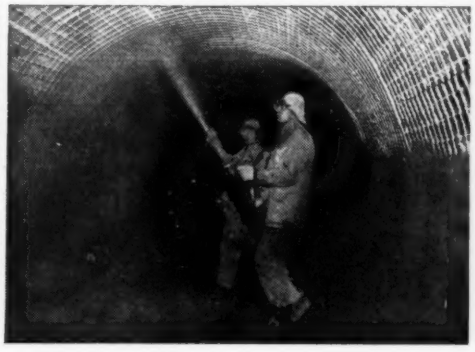
For further information on this unit, use a Reader Service Card on which is entered the above key number and your name and address.

L. C. Richardson Represents Ridge Tool In West

Announcement has been made by The Ridge Tool Co. of Elyria, Ohio, of the appointment of L. C. Richardson as sales representative of the company's Inter-mountain territory. The states under Mr. Richardson's supervision will include Missouri, Kansas, Colorado, Arkansas, and Wyoming. His headquarters are in St. Louis, Mo. Mr. Richardson was formerly with the Stockham Pipe Fittings Co. and The Grinnel Co.

"GUNITE" RENEWS OLD BRICK SEWERS





These pictures show how we are rebuilding nearly four miles of combination sanitary and storm sewers at Bloomington, Illinois, by lining them with mesh reinforced "GUNITE."

Erosion of mortar joints and dislodged bricks made many sections of these 65-year-old sewers both dangerous and inefficient. The new "GUNITE" linings will restore them to greater than original strength and result in many more decades of useful service at a fraction of the cost of new sewers.

All work is done without opening streets. Sewer service is maintained by installing temporary flumes or by-passing through relief sewers.

This job and many other profitable uses of "GUNITE" are illustrated and described in our new 64-page General Bulletin C2400. Send for your free copy today.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.

MANUFACTURERS OF THE "CEMENT GUN"

settle your coagulating problem ...fast

Here's a quicker way to settle impurities (inorganic or organic) in raw water supplies or waste water. Coagulate with N-Sol (activated silica sol)*.

Activated silica sol, conveniently made by an N-Sol Process, and used with a coagulant such as alum or iron salts, speeds clarification. The larger, denser flocs which are formed enmesh the suspended solids better, and settle faster. Try N-Sol and measure these results:

Clearer effluent
Shorter settling time
Increased filter capacity

Let the flexible, efficient N-Sol solve a water treatment problem for you. Ask for a free copy of "Activated Silica Sol in Water Treatment".

*N-Sol Processes are methods by which "N" Silicate is reacted with ammonium sulphate, chlorine, or sodium carbonate to produce activated silica sol. This, together with alum, iron or lime rapidly forms a larger, denser, faster settling floc.

Philadelphia Quartz Co.
1166 Public Ledger Bldg.,
Philadelphia 6, Pa.

N-SOL PROCESSES FOR WATER COAGULATION

Graver Expands Water Conditioning Dept.

Graver Tank & Manufacturing Co., of Chicago, has announced the establishment of the Graver Water Conditioning Co. as a division to extend the operations which have been conducted by the Graver Water Conditioning and Process Equipment Dept.

The Graver Water Conditioning Co. products include hot process softeners, deaerating heaters, zeolite softeners, cation and anion exchangers, demineralizers, clarification and filtration equipment, reactivators, and chemical feeders.

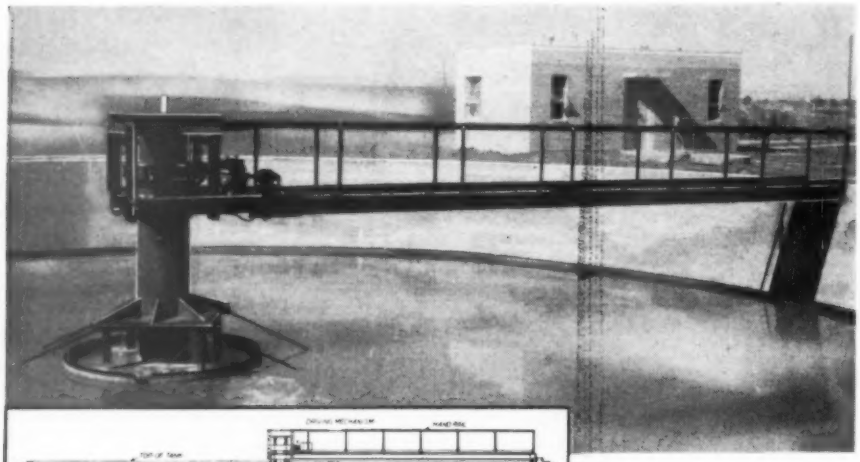
Diamond Alkali Advances Sales Executive

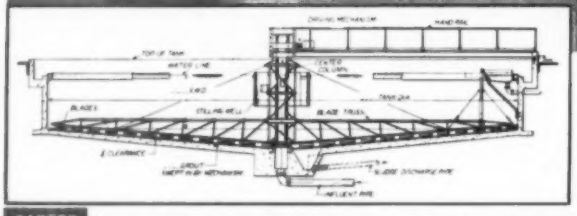
Diamond Alkali Co. of Cleveland, Ohio, has announced the advancement of Earl J. Mills to manager of the company's Southwest Sales District, consisting of Texas, Oklahoma and Kansas. He will be located at Houston, Texas.

At the same time Charles W. Klaus has been named to take complete charge of Diamond sales activities in the seven-state area of Illinois, Indiana, Iowa, Michigan, Minnesota, Wisconsin and Nebraska. Mr. Klaus will remain in the Chicago office.

John J. Carroll To Louisville For Neptune

Announcement has been made by the Neptune Meter Co., that John J. Carroll has been appointed District Manager of the Louisville Office to succeed the late Edwin L. Cantrell. Mr. Carroll joined the Neptune Meter Co. in 1937 and has represented the company in the state of Indiana as District Manager at Indianapolis since 1939.





Carter Circular Collector Type "TQB" for primary clarification at Prosser, Washington. Diameter—70'0"; SWD—8'0". Gen'l Cont.: Rushlight Automatic Sprinkler Co., Portland, Ore. Cons. Engrs.: G. D. Hall & Assocs., Yakima, Wash.

CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER CARTER

SUPERIOR CARTER DESIGN

The circular collector installation at Prosser, Washington, is another example of Carter's superior design and fabrication in the field of sanitation engineering equipment.

Our type "TQB" Circular Collector is especially designed for medium to large size installations. Exclusive features include Carter Torque Beam construction and Rotating Torque Frame and stilling well.

WRITE TODAY FOR CATALOG

Free

It's new—it's just off the press!

Complete engineering data and specifications on all three types of Carter Circular Collectors—satisfactorily serving today in the efficient, economical clarification of sewage — industrial waste—and water purification.

USE THIS COUPON

RALPH B. CARTER CO.
186 Atlantic St.
Hackensack, N. J.

Send me Clarifier Bulletin No. 4906.

Name .....

Title .....

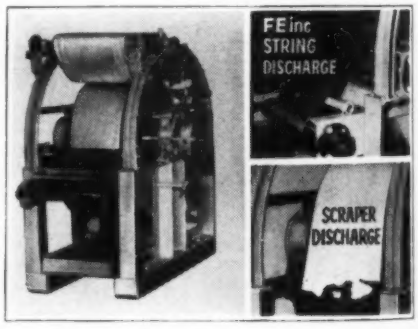
Company .....

Address .....

RALPH B. CARTER COMPANY
HACKENSACK, N. J.

1008 Pilot Plant Filter

Filtration Engineers, Inc., 155 Oraton St., Newark 4, N.J., has developed a new pilot plant filter, which has an interchangeable string or scraper discharge. This unit is



capable of handling any continuous filtering operation in small production, experimental or temporary process. It consists of a stainless steel rotary vacuum filter which permits use of either scraper discharge or the FEinc String Discharge. Both are provided with the filter.

This pilot plant can be rented from the company if desired.

To obtain further information on this unique unit, use a Reader Service Card on which is entered the above key number and your name and address.

PENNSALT

Anhydrous

Ferric Chloride

excellent coagulant

Pennsalt Ferric Chloride is an economical, efficient coagulant for use in the purification of water and the treatment of sewage and industrial waste. As a coagulant Pennsalt Ferric Chloride should be particularly considered in these connections: precipitation of sewage; sewage sludge conditioning. Pennsalt Anhydrous Ferric Chloride is available in 150 lb. and 400 lb. drums. For more information on application and prices, write: Heavy Chemicals Division, Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

PENN SALT

chemicals

Type 1038

All-Purpose Heavy-Duty Float Switch

Especially designed for sewage pumping stations where a separate float control is desirable for each pump.

This Float Switch is flexible. Adaptable for floor or wall mounting, or for vertical or overhead operation.

Watertight and Explosion-proof Cabinets

Write for Engineering DATA

Water Level Controls Division of

HEALY-RUFF COMPANY

809 HAMPDEN AVE., ST. PAUL 4, MINN.

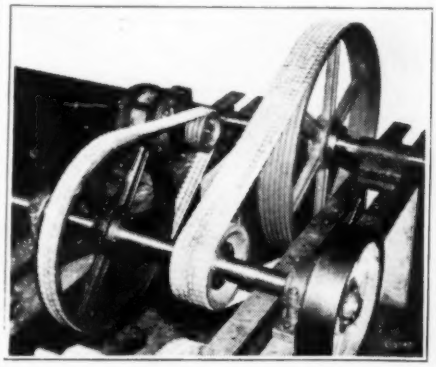
Central Engineering, Inc. To Represent "Vapor Phase"

According to an announcement of Engineering Controls, Inc., the Vapor phase Engine Cooling and Waste Heat Recovery Systems will henceforth be represented in the St. Louis area by Central Engineering, Inc., located at 2711 Olive St., St. Louis.

1009

Vee Ply Belting

Worthington Pump & Machinery Corp., Harrison, N. J., has announced the Vee Ply Belting, a quick, detachable Vee Belt, specially



designed to service emergency breakdowns and eliminate large endless belt inventory.

For further information on this Vee Ply Belting, use a Reader Service Card, on which is entered the above key number and your name and address.

Jeffrey Makes Personnel Changes

The Jeffrey Manufacturing Co., Columbus, Ohio, has announced several changes in personnel at the home and district offices. Russel W. Knode has been made Assistant Manager of the Export Division; Clark Allen replaces E. F. Abram (retired) as head of the Pricing Department; F. E. McGovern is transferred to Coal Preparation Sales and Henry W. Nau enters the Engineering Division.

H. C. Rockwell returns from District Managership at Baltimore to the Product Sales Dept. and J. R. Brisley, formerly of the Philadelphia district office, becomes District Manager at Baltimore; Charles E. Lawall, Jr., has been assigned to the Philadelphia office where R. W. Sweitzer is District Manager.

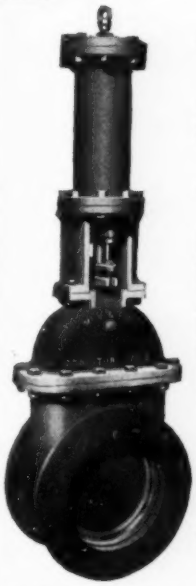
HYDRANTS & VALVES

Pipe Line Accessories for Water Works and Sewage Works

Write for Catalog No. 34

VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals.



LEFT:
HYDRAULIC GATE VALVE
For quick and easy operation by remote control.

M & H PRODUCTS INCLUDE

FIRE HYDRANTS
GATE VALVES
TAPPING VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

1010

Cation Exchanger

The Resinous Products Div. of Rohm & Haas Co., Philadelphia, has announced a new high-capacity cation exchange resin in commercial quantities.

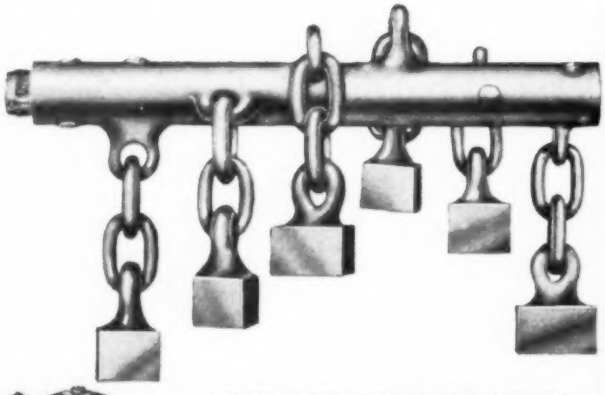
Known as Amberlite IR-120, this relatively new member of the Amberlite family is used for domestic and industrial water softening, and for special processing applications which require a cation exchange resin of high capacity and high physical and chemical stability.

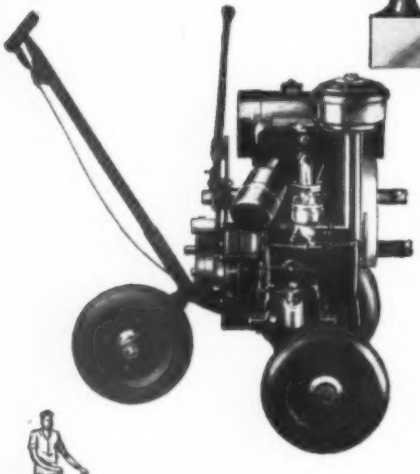
The resin shows an adsorptive capacity of 30 kilograms per cu. ft. at efficient regeneration levels and extremely high efficiency at reduced capacity levels. Flow rates as high as 10 gal. per cu. ft. per minute, equal to 25 gal. per sq. ft. per minute in a bed of 30 in. depth, have been used with less than 5 per cent reduction in capacity.

To obtain further information about this new high-capacity cation exchange resin, mail a Reader Service Card on which is entered the above key number and your name and address.

PRACTICAL PIPE LINE CLEANING TOOLS FOR PRACTICAL MEN

"Flexible" Power Tools for Cleaning Pipe in Short Sections—in Diameters Ranging from 4 Inches to 12 Inches.





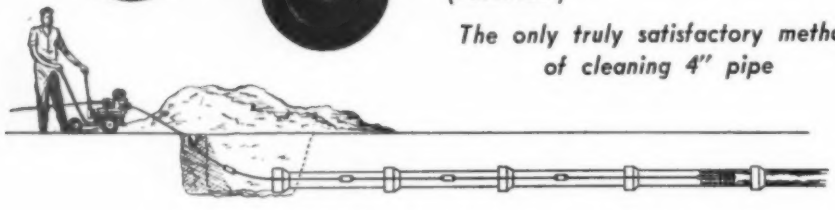
"FLEXIBLE" CHAIN HEAD AUGER

Cleans right down to the metal. Has never been known to break a pipe or damage a corporation cock. (Patented.)

"FLEXIBLE" POWER DRIVE

Powerful, portable power drive unit. Simple, safe to handle. Furnished with dependable 4 H.P., plus engine. (Patented.)

The only truly satisfactory method of cleaning 4" pipe



"FLEXIBLE" EQUIPMENT NOW FOR SALE, LEASE OR CONTRACT.

Write the nearest office today for full particulars.

FLEXIBLE UNDERGROUND PIPE CLEANING CO.

9059 Venice Blvd., Los Angeles 34, California

141 W. Jackson Blvd. Chicago, Ill.
29 Cordan Ave. Roslindale 31, Mass.
401 Broadway New York 13
P. O. Box 447 Lancaster, Texas
147 Hillside Ter. Irvington, N. J.
41 Greenway St. Hamden, Conn.
P. O. Box 165 Atlanta
3786 Durango Ave. Los Angeles 34, Calif.
2011 Central Ave. Memphis, Tenn.
909 N. Homewood Ave. Pittsburgh 8, Pa.
801 E. Excelsoir Blvd. Hopkins, Minn.
4455 S.E. 24th Ave. Portland 2, Ore.

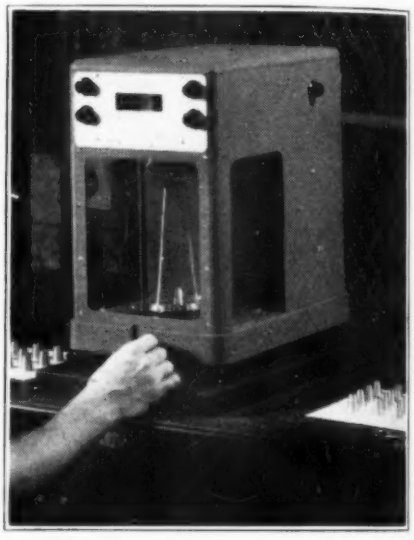
Builders and Omega Machine Move Chicago Office

Builders-Providence and Omega Machine Co. have moved their Chicago office to 1141-43 Greenleaf Ave., Wilmette, Ill.

1011

New Analytical Balance

Fisher Scientific Co., Pittsburgh, Pa., has introduced a new type of direct-reading laboratory balance called the "Gram-atic Balance." The new balance has only one pan, and the weight reads directly on a scale at eye level, thus eliminating a usual source of error in adding up individual weights. The balance is particularly adaptable for use in water



and sewage treatment plant laboratories for the determination of total residue, calcium, magnesium, silica, or other tests where balances are used. The balance has a sample range from 200 grams to 0.0001 gram. The beam of the balance has a constant load; hence, sensitivity remains constant regardless of sample size.

To obtain further information on this balance, use a Reader Service Card on which is entered the above key number and your name and address.

Dorr Co. Moves Headquarters To Stamford, Conn.

The Dorr Co. will move its headquarters to Stamford, Conn., in December of this year. The company is presently located at 570 Lexington Ave., New York, N.Y. The move is being made to provide larger office

space and better working conditions in a less crowded atmosphere, for the main office staff of approximately 225 persons.

The new office will be located in the Northam Warren Building on Barry Place, Stamford.

The company is eventually to construct a building in the Stamford area as a permanent location for the home office.

F. M. Mason Engineering Director for Fairbanks, Morse

Fairbanks, Morse & Co., has announced the appointment of Frank M. Mason, Jr., as Director of Engineering. He will continue to be located at the headquarters office in Chicago, Ill. For several years prior to his recent appointment, Mr. Mason has been Manager of the Research Division in charge of all research, developments and patents. He joined the company in 1922 following his graduation from Northwestern University.

S. B. Applebaum Heads Cochrane Cold Process Division

Cochrane Corp., Philadelphia, Pa., has announced the appointment of Samuel B. Applebaum as Manager of the company's Cold Process Water Treating Division. Mr. Applebaum is also Vice President of the Liquid Conditioning Corp., an operating subsidiary of Cochrane. He was formerly Vice President of Permutit Co. and later President of the Liquid Conditioning Corp. before its purchase by the Cochrane Corp.

Another 50 Ft. Dia. Spiraflo Clarifier, Sherman, Texas. Koch and Fowler, Engineers, Dallas, Texas

If you want to improve your sewage plant effluent, we urge you to investigate our Spiraflo Clarifier. Excellent skimming and settling by the Spiraflo means better results. For a test comparison between actual quiesent settling and Spiraflo results see our new Spiraflo bulletin off the press in September 1949.

Lakeside's new water softener bulletin No. 78 is chuck full of valuable information for the designing engineer, purchaser and operator. If you have not received a copy please write for one.

LAKESIDE ENGINEERING CORPORATION

222 WEST ADAMS STREET **CHICAGO 6, ILLINOIS**

Morse Boulger combination unit for complete reduction of sewage sludge and refuse.

Select from this list of five different types and you will get the best type for your particular problem whether it is trash, garbage, sewage sludge, institutional organic matter . . . separately or in combination.

***For Garbage and Rubbish**
(1) Cell and Hearth
(2) Circular Hearth and Grates—Mechanically Stoked
***For Sewage Sludge Drying and/or Burning**
(3) Multiple Zone Furnace—Mechanically Stoked
***For Garbage, Rubbish and Sewage Sludge**
(4) Circular Unit, Mechanically Stoked, with Separate Compartment for Sewage Sludge Reduction
***For Garbage and Trash (Individual Buildings)**
(5) Kernerators (Flue-Fed and Ready-Built)

Our incinerator experience goes back nearly sixty years. Our work is guaranteed. Our incinerators are constructed under the supervision of our own field men who stay with it until the unit is in operation, fully broken in and crews instructed.

MORSE BOULGER DESTRUCTOR CO.

205-W East 42nd St., New York 17, N.Y.
Representatives in Principal Cities

Bury it and Forget it!

EDDY
DOUBLE GATE VALVE

Since 1869 EDDY For Long Service

If you will think before buying a valve—you can eliminate thinking of it forever after. When you think of valves—think of the years of time and effort we have put into giving you a smooth-operating, trouble-free valve. Think of the progressive water works men who have relied on Eddy Valves for years—then specify and insist on getting Eddy Valves—you can bury them and forget them.

EDDY
VALVE COMPANY
WATERFORD NEW YORK
A subsidiary of James B. Clow & Sons

J. C. Toomey Heads Chain Belt Detroit Office

Chain Belt Co. of Milwaukee, Wis., has announced the appointment of John C. Toomey as District Sales Engineer in the Detroit District Office. Mr. Toomey has 20 years of experience in the field and now resides in Lansing, Mich.

LITERATURE AND CATALOGS

1012
VERSATILE HYDRAULIC CRANE

There is apparently no end to the variety of jobs that can be done with a Bucyrus-Erie mobile **"Hydrocrane"** in water and sewage works construction, operation, maintenance and repair. This versatile crane with telescoping boom is truck mounted and hydraulically revolves through 370° in either direction. All operations are performed through hand levers, avoiding foot work, and providing precision control as evidenced by the straight and true trench that can be dug with the clamshell bucket alone. Secret of precision work is the fully hydraulic operation of the clam-shell as contrasted with the gravity type bucket. Under hydraulic closing power the bucket actually bites in and never tends to back off from the load. Amongst other accessories than the clam-shell is an orange-peel catch basin cleaning bucket and a 3-tine grapple. Simplicity of operation and control is claimed as an outstanding feature. Another is the ability to use the machine in close quarters and in spaces when head room is sparse, such for example bring the removal of sand from filters and similar jobs within buildings; trenching, pipe laying and back-filling under trees with low spreading branches. Owners of the "Hydrocrane" marvel at its simplicity of operation, ease of learning pinpoint spot control of telescopic boom and buckets.

The "Hydrocrane" comes in two capacities—the H-2 for two ton ¼ yd. bucket and H-3 for three ton ⅜ yd. bucket. If interested in such money saving equipment fill out a Reader Service Card with the number of this item and request more information on the Bucyrus-Erie "Hydrocrane."

FOR BETTER
pH Control
and WATER TESTS
there is nothing like

NON-FADING GLASS COLOR STANDARDS

Pocket Comparator No. 605

Permanent reliability of Hellige Glass Color Standards, accuracy of color comparison, simplicity of technique, and compactness of the apparatus are exclusive features of Hellige Comparators.

WRITE FOR BULLETIN No. 602

HELLIGE
INCORPORATED
3718 NORTHERN BLVD. LONG ISLAND CITY 1, N.Y.
HEADQUARTERS FOR COLORIMETRIC APPARATUS

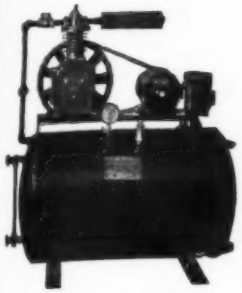
FREE WRITE FOR THIS BOOK BY DR. HALE
Tells How To
CONTROL ALGAE

••• AN AUTHORITATIVE WORK CONCERNING THE CONTROL OF MICRO-ORGANISMS AND ELIMINATION OF TASTES AND ODORS. This enlarged edition, by Dr. Frank E. Hale,* describes in detail methods of controlling various forms of microscopic life commonly dealt with in water supply systems. Descriptive material includes 48 clear photo-micrograph studies of organisms discussed. ... Many of the most important water works specify Nichols *Triangle Brand* Copper Sulphate. Triangle Brand is available in several convenient sizes for water treatment. Write *today* for details and book.
*(Director of Laboratories, Dept. of Water Supply, City of New York)

THE STANDARD FOR OVER 50 YEARS

NICHOLS TRIANGLE BRAND COPPER SULPHATE 99% + PURE

MADE BY
PHELPS DODGE REFINING CORPORATION
Electrolytic Refiners of Copper
40 Wall Street, New York 5, N.Y. — 230 North Michigan Avenue, Chicago 1, Ill.



No. 2V-APCO

APCO-V-APCO PRIMERS

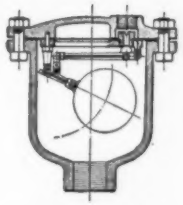
AUTOMATIC POWER OR TANK PRIMERS

AIR RELEASE VALVES

FOR

FILTER PIPE LINES—DISTRIBUTION LINES AND OTHER USES

17 TYPES



No. 200 VALVE

VALVE AND PRIMER CORPORATION **127 N. Dearborn St., Chicago 2, Ill.**

1013

INDUSTRIAL WASTE NEUTRALIZATION

Leeds & Northrup Co., 4902 Stenton Avenue, Philadelphia 44, Pa., publishes a house organ known as **Modern Precision.** In Vol. 9, No. 1, there appears an article on "Industrial Waste Neutralization Aided by Micromax pH Control." This article tells the story of a waste neutralization system constructed for the Western Electric Co. at Allentown, Pa., where the waste must be treated before being discharged into the Lehigh River.

To obtain a copy of "Modern Precision" use a Reader Service Card on which is entered the above key number and your name and address.

1014

GARBAGE DISPOSER

Hot Point, Inc., 5600 W. Taylor St., Chicago 44, Ill., has issued a 2-page sheet on the **Hot Point Disposall** Garbage Disposer. Diagrams of the unit are shown, as is installation and operation.

To obtain a copy, use a Reader Service Card on which is entered the above key number and your name and address.

1015

CARRYABLE GENERATORS

Homelite Corp., Port Chester, N. Y., has available a bulletin on **Homelite Carryable Generators.** This bulletin shows these gasoline engine driven generators being used for a wide variety of purposes. It also shows the complete portability of this equipment.

To obtain a copy of this bulletin describing these Carryable Generators and their uses, mail a Reader Service Card, on which is entered the above key number and your name and address.

...of a Superior COAGULANT

SEVEN ADVANTAGES OF FERRI-FLOC

1. Coagulation is effective over a much wider pH range than with other coagulants. Color flocs may be formed in the very acid range where other coagulants may not be employed. On the other hand, true hydrated ferric oxide flocs may be formed at pH 9-10 or even higher for the removal of turpidity and manganese.
2. The time required for floc formation, conditioning and settling is in many cases considerably shorter than that required for other coagulants.
3. Filter runs have been markedly increased in several cases.
4. Manganese is successfully removed at pH values above 9.
5. Effluents may be produced which are exceedingly low in both iron and aluminum.
6. Hydrogen Sulphide is removed and taste and odors improved.
7. Ferri-Floc does not seem to stick to sand grain to form mud balls, and is subject to less "breaking through" on the filters.

Let us send you FREE, this valuable booklet on Ferri-Floc.
Write TENNESSEE CORPORATION,
Grant Bldg., Atlanta, Ga.

Many of the country's larger plants are now recognizing the advantages offered by Ferric Coagulants and are taking advantage of them through Ferri-Floc. — Ferri-Floc eliminates the troubles encountered with other coagulants by improving general quality, reducing overall cost. — All of this is accomplished without costly changes in plant equipment.

TENNESSEE CORPORATION
Atlanta, Georgia — Lockland, Ohio

DESIGN and FABRICATION

Handling sewage gas from digestion tanks is one of Norwalk Valve's activities in the manufacture of pressure control equipment. Design and fabrication of installations from digestion tank to gas engines and heating units to meet your needs.

- *Made with ASTM and other specification materials to fit your specs.*
- *Outline your requirements in a note to us, we'll be glad to suggest designs and equipment. We'll send along a catalogue of gas control equipment.*

Stock lines include check valves, pressure relief valves, regulators, all sizes and pressure. Illustrated is the Norwalk "Meter Cop" (a Norwalk exclusive).

NORWALK VALVE COMPANY
33 RAILROAD AVE.
SOUTH NORWALK, CONN.

Quality that Lives

Mechanical equipment for water filtration that carries the Roberts Filter nameplate has long been recognized as equipment that gives lasting service. Installations thirty and more years old are still working "round the clock". However, even the finest equipment may need a replacement part occasionally, then you'll be glad you have Roberts Filter, for no part, however small, is an orphan after installation. Replacement parts can be supplied quickly, eliminating delays that are not only costly but often vital.

For water treatment equipment with quality that lives—specify Roberts Filter.

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MANUFACTURING CO.
607 COLUMBIA AVE., DARBY, PA.

1016
VITRIFIED CLAY PIPE

Universal Sewer Pipe Corp., 1500 Union Commerce Bldg., Cleveland 14, Ohio, has issued **"A Photographic Story of Universal Vitrified Clay Pipe".**

This bulletin gives, as its name indicates, a collection of interesting photographs of the installation of vitrified sewer pipe.

To obtain a copy of this interesting folder, mail a Reader Service Card on which is entered the above key number and your name and address.

1017
DIAPHRAGM CONTROL VALVES

Minneapolis-Honeywell Regulator Co., Wayne & Roberts Aves., Philadelphia 44, Pa., has issued a new catalog on the **Belfield Diaphragm Control Valves.** This is the bulletin which describes and shows drawings of the diaphragm motor control valve with radiation fins and positioner, direct acting and reverse acting diaphragm motor control valve with manual operator, a pilot operated valve, Venturi throat valve, 3-way, duplex and single-seated valves, etc.

To obtain a copy of this bulletin on diaphragm control valves, use a Reader Service Card on which is entered the above key number and your name and address.

1018
ELEVATED STEEL TANKS

Chicago Bridge & Iron Co., Michigan Ave., Chicago, Ill., has issued a bulletin on **Horton Ellipsoidal Bottom Elevated Steel Tanks.** These tanks are of welded construction. The bulletin is complete, showing various styles and designs of the welded tanks including 4 post-3 panel, 4 post-2 panel, 6 post-2 panel, 6 post-3 panel, 4 post-4 panel, 8 post-3 panel, and other designs. A running commentary in the bulletin shows the advantages and uses of these various tanks.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

1019
CLARIFIER

Infilco, Inc., 325 W. 25th Place, Chicago 16, Ill., has issued a new bulletin on **"Quiescent Clarification."** This bulletin contains a description of Infilco's smooth-settling clarifiers.

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Shown in the bulletin are the peripheral driven clarifiers, and the mechanism involved therein, as well as a discussion of the automatic hydraulic skimmer. Also shown is the centrally-driven clarifier and its mechanism.

The bulletin contains complete information and specifications on these various types of clarifiers.

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1020
CENTRIFUGAL PUMP CARE

The Allis-Chalmers Mfg. Co., 1192 S. 70th St., Milwaukee, Wis., has released its revised **Handbook for the Care of Centrifugal Pumps.** The booklet tells how to figure head loss, carries tables to determine total friction loss, and gives information on causes and cures for various sources of troubles. The bulletin includes little known facts about cavitation and how to protect pumps against it, water's role as a lubricant in pumps, and common mistakes in packing stuffing boxes.

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1021
PIPE AND TUBE BENDING

The Copper & Brass Research Assoc., 420 Lexington Ave., New York 17, N.Y., has issued the fourth edition of its **Pipe and Tube Bending Handbook.**

This bulletin is complete with data on the principles of bending, bending devices, principles of bending machines, typical bending equipment, and wrinkle-bending of non-ferrous pipe and tube. In short, this bulletin covers all the practical methods for bending pipe and tubes of copper, brass, and related alloys.

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1022
WATER METERS

The Buffalo Meter Co., 2914 Main Street, Buffalo 14, N.Y., has reprinted its bulletin giving List Prices and Specifications for **American and Niagara Water Meters.** The bulletin shows the various types of meters available, the solid casting type and the frost bottom type; also specifications for the parts.

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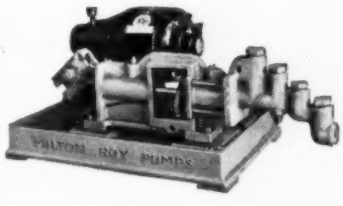

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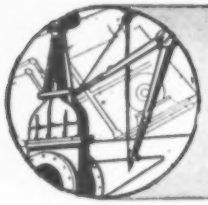

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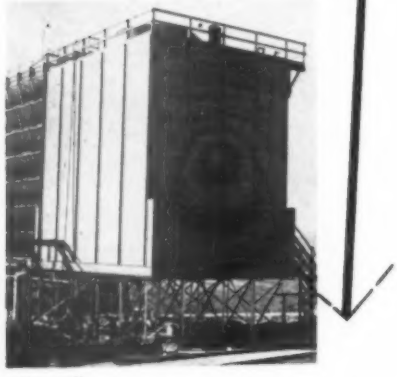

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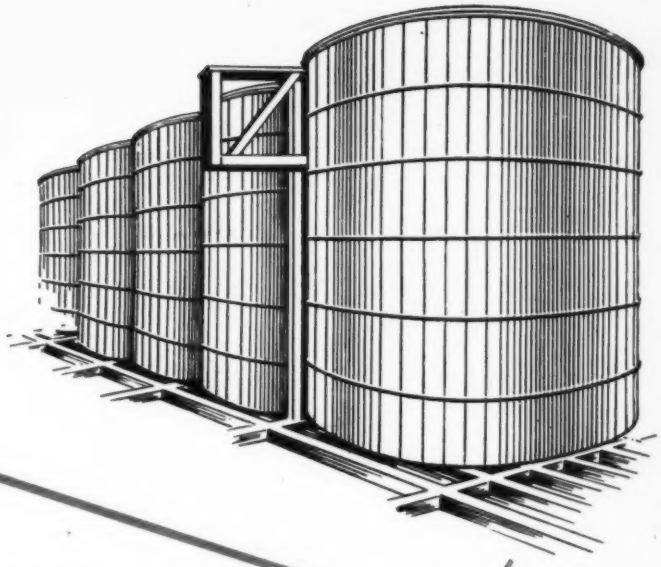

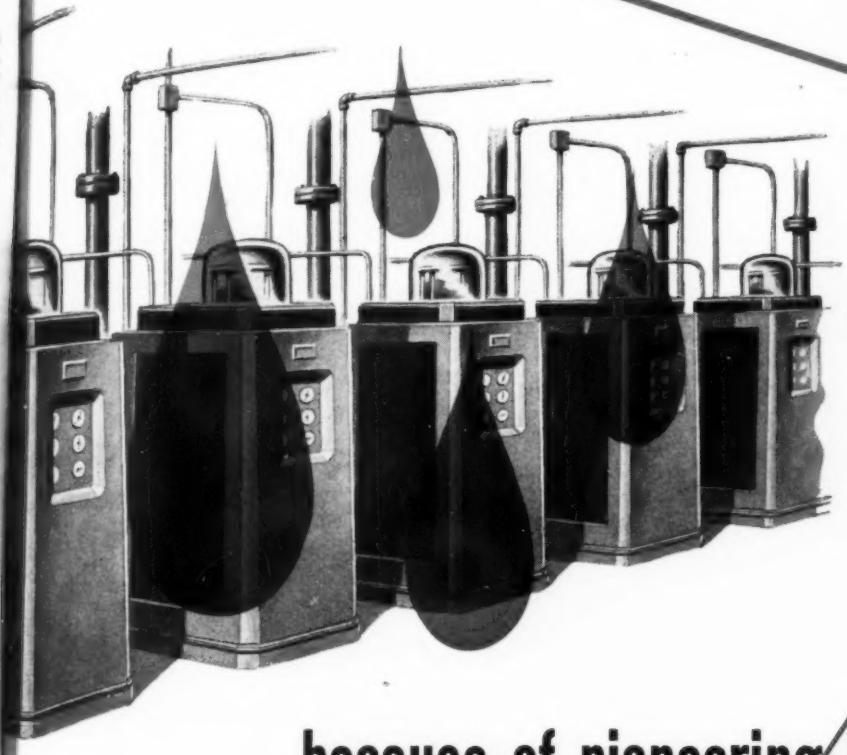

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